

FBISE

CHEMISTRY

NOTES

Federal Board Islamabad
Presented by:

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STUDY GROUP

9TH
CLASS

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CHEMISTRY FOR 9TH CLASS (UNIT # 1)

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REVIEW QUESTIONS

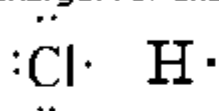
[Very Important] Differentiate between anion and a free radical.

Anion: -

- **Ion** is a charged species formed from an atom by adding or removing electrons.
- Positively charged ions are called **cations**.
- Negatively charged ions are called **anions**.
- For example Na forms Na^+ by losing one electron and chlorine atom gains one electron and forms Cl^- ion.

Free radicals:

A free radical is an atom, which has an Un-paired electron and bears no electrical charge. For example:



When substances like halogens are exposed to sun light, their molecules split up into free radicals.

[Important] What do you know about corpuscular nature of matter?

Empedocles concept:

An ancient Greek philosopher, Empedocles thought that all materials are made up of four things called elements. i.e. Earth, Air, Water and Fire

Plato concept:

Plato adopted Empedocles theory and evolves the term element to describe these four substances.

Aristotle concept:

Aristotle also adopted the concept of four elements. He introduced the idea that elements can be differentiated on the basis of properties such as hot versus cold and wet versus dry.

The Greek concept of four elements existed for more than **2000 years**.

[Important] Differentiate between analytical chemistry and environmental chemistry.

Analytical Chemistry:

The branch of Chemistry that deals with the methods and instruments for determining the composition of matter is called Analytical Chemistry.

Environmental Chemistry:

The branch of Chemistry that deals with the chemicals and toxic substances that pollute the environment and their adverse effects on human beings is called environmental chemistry.

[Very Important] What is mole and Avogadro Number?

- The amount of matter that contains as many atoms, ions or molecules as the number of atoms in exactly 12g of C-12 is called mole.

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- Mole can also be defined as atomic mass, molecular mass or formula mass expressed in grams.

$$\text{Number of moles of a substance} = \frac{\text{Mass in grams}}{\text{Molecular Mass}}$$

- A mole is an amount of a substance that contains 6.02×10^{23} particles of that substance. This experimentally determined number is known as **Avogadro number**.
- The symbol of mole is "mol".

Example:

For example a mole of carbon is 6.02×10^{23} atoms. A mole of sulphur is 6.02×10^{23} atoms. A mole of water is 6.02×10^{23} molecules

[Very Important] Differentiate between empirical formula and molecular formula.

Empirical Formula:

- The empirical formula of a compound is the chemical formula that gives the whole number ratio of atoms of each element.
- It represents the simple whole number ratio of atoms of elements in compound.
- It is used for both molecular and ionic compounds.
- CH_2O and CH are empirical formulae of glucose and benzene.

Molecular Formula:

- A molecular formula gives the actual whole number ratio of atoms of each element present in a compound.
- A formula which represents actual number of atoms of elements in compound.
- It is used for molecular compounds.
- $\text{C}_6\text{H}_{12}\text{O}_6$ and C_6H_6 are empirical formulae of glucose and benzene.

Question: What is the number of molecules in 9.0 g of steam?

$$\text{Mass in grams} = 9 \text{ g}$$

$$\text{Molar mass of steam (H}_2\text{O)} = (2 \times 1) + (1 \times 16) = 18 \text{ g}$$

$$\text{Number of Molecules} = \frac{\text{Mass in Grams}}{\text{Molar Mass}} \times N_A$$

$$\text{Number of Molecules} = \frac{9}{18} \times 6.022 \times 10^{23}$$

$$\text{Number of Molecules} = 0.5 \times 6.022 \times 10^{23}$$

$$\text{Number of Molecules} = 3.011 \times 10^{23} \text{ Molecules}$$

ختم نبوت ﷺ زندہ باد

عظمت صحابہ زندہ باد

السلام علیکم ورحمۃ اللہ وبرکاتہ:

معزز ممبران: آپ کا وٹس ایپ گروپ ایڈمن "اردو بکس" آپ سے مخاطب ہے۔

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- ❖ گروپ میں معزز، پڑھے لکھے، سلجھے ہوئے ممبرز موجود ہیں اخلاقیات کی پابندی کریں اور گروپ رولز کو فالو کریں بصورت دیگر معزز ممبرز کی بہتری کی خاطر ریموو کر دیا جائے گا۔
- ❖ کوئی بھی ممبر کسی بھی ممبر کو انباکس میں میسج، مس کال، کال نہیں کرے گا۔ رپورٹ پر فوری ریموو کر کے کارروائی عمل میں لائے جائے گی۔
- ❖ ہمارے کسی بھی گروپ میں سیاسی و فرقہ واریت کی بحث کی قطعاً کوئی گنجائش نہیں ہے۔
- ❖ اگر کسی کو بھی گروپ کے متعلق کسی قسم کی شکایت یا تجویز کی صورت میں ایڈمن سے رابطہ کیجئے۔
- ❖ سب سے اہم بات:

گروپ میں کسی بھی قادیانی، مرزائی، احمدی، گستاخ رسول، گستاخ امہات المؤمنین، گستاخ صحابہ و خلفائے راشدین حضرت ابو بکر

صدیق، حضرت عمر فاروق، حضرت عثمان غنی، حضرت علی المرتضیٰ، حضرت حسنین کریمین رضوان اللہ تعالیٰ اجمعین، گستاخ اہلبیت یا

ایسے غیر مسلم جو اسلام اور پاکستان کے خلاف پراپیگنڈا میں مصروف ہیں یا ان کے روحانی و ذہنی سپورٹرز کے لئے کوئی گنجائش نہیں

ہے لہذا ایسے اشخاص بالکل بھی گروپ جو ان کرنے کی زحمت نہ کریں۔ معلوم ہونے پر فوراً ریموو کر دیا جائے گا۔

❖ تمام کتب انٹرنیٹ سے تلاش / ڈاؤنلوڈ کر کے فری آف کاسٹ وٹس ایپ گروپ میں شیئر کی جاتی ہیں۔ جو کتاب نہیں ملتی اس کے لئے معذرت کر

لی جاتی ہے۔ جس میں محنت بھی صرف ہوتی ہے لیکن ہمیں آپ سے صرف دعاؤں کی درخواست ہے۔

❖ عمران سیریز کے شوقین کیلئے علیحدہ سے عمران سیریز گروپ موجود ہے۔

❖ لیڈرز کے لئے الگ گروپ کی سہولت موجود ہے جس کے لئے ویریفیکیشن ضروری ہے۔

❖ اردو کتب / عمران سیریز یا سٹیڈی گروپ میں ایڈ ہونے کے لئے ایڈمن سے وٹس ایپ پر بذریعہ میسج رابطہ کریں اور جواب کا انتظار فرمائیں۔ برائے

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جائے گا۔

نوٹ: ہمارے کسی گروپ کی کوئی فیس نہیں ہے۔ سب فی سبیل اللہ ہے

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پاکستان زندہ باد

اللہ تبارک تعالیٰ ہم سب کا حامی و ناصر ہو

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Question: What are the molar masses of uranium-238 and uranium-235?

Molar mass of uranium -238 = Atomic mass of Uranium -238 = 238 g

Molar mass of uranium -235 = Atomic mass of Uranium -235 = 235 g

Question: Why one mole of hydrogen molecules and one mole of H-atoms have different masses?

One-mole quantities of two different substances have different masses for the same reason - the substances have different compositions.

If we put one mole of hydrogen molecules and one mole of H-atoms on separate balances, we would see a difference in mass, just as you do for the eggs and the times. This occurs because hydrogen molecules differ from H-atoms. Thus, the mass of 6.02×10^{23} hydrogen molecules does not equal to the mass of 6.02×10^{23} H-atoms.

1mole of H-atom = 1g, 1 mole of H_2 = $1 \times 2 = 2g$)

[Important] Define ion, molecular ion, formula unit, free radical, atomic number, mass number, atomic mass unit.

Ion:

- **Ion** is a charged species formed from an atom by adding or removing electrons.
- Positively charged ions are called **cations**.
- Negatively charged ions are called **anions**.
- For example Na forms Na^+ by losing one electron and chlorine atom gains one electron and forms Cl^- ion.

Molecular ion:

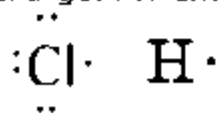
- When a molecule loses or gains electrons, the resulting species is called a molecular ion.
- For example O_2 when loses one electron it forms O_2^+ ion but when it absorbs an electrons it forms O_2^- ion. These ions are called molecular ions.
- These are short lived species and only exist at high temperature. Molecular ions do not form ionic compounds.

Formula unit:

- Formula unit is the simplest formula of an ionic compound.
- A formula unit, as the name implies, is one unit, where atom, ion or molecule corresponds to given formula.
- For example One formula unit of NaCl has one Na^+ ion and one Cl^- ion. One formula unit of $MgBr_2$ has One Mg^{2+} ion and two Br^- ions.

Free radicals:

A free radical is an atom, which has an Un-paired electron and bears no electrical charge. For example:



When substances like halogens are exposed to sun light, their molecules split up into free radicals.

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

Atomic number:

- The number of protons in the nucleus of an atom is known as its atomic number.
- For example there is only one proton in the nucleus of H-atom; therefore its atomic number is 1.

Mass number:

- The total number of protons and neutrons in an atom is known as its mass number.
- Number of neutrons = mass number - atomic number

Atomic mass unit:

One atomic mass unit (amu) is defined as a mass exactly equal to one-twelfth the mass of one C-12 atom.

[Important] Question: Differentiate between an atom and ion.

- An ion makes up the electric charge of an atom. It can be a positively charged atom or a negatively charged atom, depending on the number of protons versus electrons.
- On the other hand, an atom is the smallest part of an element composed of electrons, protons, and the neutrons.

[Important] Question: Differentiate between molecular ion and free radical.

- Polyatomic and molecular ions are often formed by the combination of elemental ions such as H^+ with neutral molecules or by the loss of such elemental ions from neutral molecules. Many of these processes are acid-base reactions.
- A radical ion is a free radical species that carries a charge. Radical ions are encountered in organic chemistry as reactive intermediates.

Question: Describe how Avogadro number is related to mole of any substance.

$$\begin{aligned} \text{One mole of a Substance} &= 6.02 \times 10^{23} \text{ atoms / molecules.} \\ \text{Number of moles of substance} &= \frac{\text{Number of molecules of substance}}{N_A} \\ \text{Number of moles of substance} &= \frac{\text{Number of molecules of substance}}{6.02 \times 10^{23}} \end{aligned}$$

One mole of hydrogen atoms = 6.02×10^{23} atoms of hydrogen (H) = 1 a.m.u.

One mole of hydrogen molecule = 6.02×10^{23} molecules of hydrogen (H_2) = 2 a.m.u

[Very Important] Question: Calculate the number of moles of each substance in samples with the following masses.

2.4 g of He:

Mass of Helium (He) = 2.4 g
 Molar Mass of Helium = 4g

$$\text{Number of Moles} = \frac{\text{Mass in grams}}{\text{Molar Mass}} = \frac{2.4}{4} = 0.6 \text{ moles}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

250mg of Carbon:

$$\begin{aligned}\text{Mass of Carbon} &= 250\text{mg} = 250/1000 = 0.25\text{g} \\ \text{Molar Mass of Carbon} &= 12\text{g}\end{aligned}$$

$$\begin{aligned}\text{Number of Moles} &= \frac{\text{Mass in grams}}{\text{Molar Mass}} = \frac{0.25}{12} = 0.021 \text{ moles}\end{aligned}$$

15g of Sodium Chloride:

$$\begin{aligned}\text{Mass of Sodium Chloride (NaCl)} &= 15\text{g} \\ \text{Molar Mass of NaCl} &= 23+35.5 = 58.5\text{g}\end{aligned}$$

$$\begin{aligned}\text{Number of Moles} &= \frac{\text{Mass in grams}}{\text{Molar Mass}} = \frac{15}{58.5} = 0.256 \text{ moles}\end{aligned}$$

40g of Sulphur:

$$\begin{aligned}\text{Mass of Sulphur} &= 40\text{g} \\ \text{Molar Mass of Sulphur} &= 32\text{g}\end{aligned}$$

$$\begin{aligned}\text{Number of Moles} &= \frac{\text{Mass in grams}}{\text{Molar Mass}} = \frac{40}{32} = 1.25 \text{ moles}\end{aligned}$$

1.5Kg of MgO:

$$\begin{aligned}\text{Mass of MgO} &= 1.5\text{Kg} = 1500\text{g} \\ \text{Molar Mass of MgO} &= 24+16 = 40\text{g}\end{aligned}$$

$$\begin{aligned}\text{Number of Moles} &= \frac{\text{Mass in grams}}{\text{Molar Mass}} = \frac{1500}{40} = 37.5 \text{ moles}\end{aligned}$$

[Very Important] Question: Calculate the mass in grams of each of the following samples

1.2 moles of K:

$$\begin{aligned}\text{Number of moles of potassium (K)} &= 1.2 \text{ moles} \\ \text{Molar mass of potassium (K)} &= 39 \text{ g} \\ \text{Mass in gram} &= \text{Number of moles} \times \text{Molar mass} \\ &= 1.2 \times 39 = 46.8 \text{ g}\end{aligned}$$

75 moles of H₂

$$\begin{aligned}\text{Number of moles of hydrogen (H}_2\text{)} &= 75 \text{ moles} \\ \text{Molar mass of hydrogen (H}_2\text{)} &= 2 \times 1 = 2\text{g} \\ \text{Mass in gram} &= \text{Number of moles} \times \text{Molar mass} \\ &= 75 \times 2 = 150\text{g}\end{aligned}$$

0.25 moles of steam:

$$\begin{aligned}\text{Number of moles of hydrogen (H}_2\text{O)} &= 0.25 \text{ moles} \\ \text{Molar mass of hydrogen (H}_2\text{O)} &= 2 \times 1 + 16 = 18\text{g} \\ \text{Mass in gram} &= \text{Number of moles} \times \text{Molar mass} \\ &= 0.25 \times 18 = 4.5\text{g}\end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

1.05 moles of CuSO₄.5H₂O

Number of moles of CuSO₄.5H₂O = 1.05 moles
Molar mass of CuSO₄.5H₂O = 63.5 + 32 + 4x16 + 5(2x1+16)
= 63.5 + 32 + 64 + 5(18)
= 249.5g
Mass in gram = Number of moles x Molar mass
= 1.05 x 249.5 = 261.96 g

0.15 moles of H₂SO₄

Number of moles of H₂SO₄ = 0.15 moles
Molar mass of H₂SO₄ = 2x1 + 32 + 4x16
= 2 + 32 + 64 = 98 g
Mass in gram = Number of moles x Molar mass
= 0.15 x 98 = 14.7 g

[Very Important] Question: Calculate the number of molecules present in each of the following samples.

2.5 moles of carbon dioxide:

Number of moles = 2.5 moles
Avogadro's number = $N_A = 6.022 \times 10^{23}$
Number of molecules = Number of moles x N_A
= $2.5 \times 6.022 \times 10^{23}$
= 15.055×10^{23}
= 1.505×10^{24} Molecules

3.4 moles of ammonia (NH₃):

Number of moles = 3.4 moles
Avogadro's number = $N_A = 6.022 \times 10^{23}$
Number of molecules = Number of moles x N_A
= $3.4 \times 6.022 \times 10^{23}$
= 20.5×10^{23}
= 2.05×10^{24} Molecules

1.09 moles of benzene, (C₆H₆):

Number of moles = 1.09 moles
Avogadro's number = $N_A = 6.022 \times 10^{23}$
Number of molecules = Number of moles x N_A
= $1.09 \times 6.022 \times 10^{23}$
= 6.56×10^{23} Molecules

0.01 moles of acetic acid (CH₃COOH):

Number of moles = 0.01 moles
Avogadro's number = $N_A = 6.022 \times 10^{23}$
Number of molecules = Number of moles x N_A
= $0.01 \times 6.022 \times 10^{23}$
= 0.062×10^{23}
= 6.02×10^{21} Molecules

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

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Question: Decide whether or not each of the following is an example of empirical formula:

Al₂Cl₆:

No, since, 2 : 6 is not the simplest whole number ratio therefore Al₂Cl₆ is not empirical formula. Hence, Al₂Cl₆ is a molecular formula.

Hg₂Cl₂:

No, since, 2 : 2 is not the simplest whole number ratio, therefore Hg₂Cl₂ is not empirical formula. Hence, Hg₂Cl₂ is a molecular formula.

NaCl:

Yes, since, 1 : 1 is the simplest whole number ratio therefore NaCl is empirical formula.

C₂H₆O:

Yes, since, 2 : 6 : 1 is the simplest whole number ratio therefore C₂H₆O is empirical formula,

Question: TNT or trinitrotoluene is an explosive compound used in bombs. It contains 7 C-atoms, 6 H-atoms, 5 N-atoms and 6 O-atoms. Write its empirical formula.

C₇H₆N₅O₆

Question: A molecule contains four phosphorus atoms and ten oxygen atoms. Write the empirical formula of this compound. Also determine the molar mass of this molecule.

Molecular formula = P₄O₁₀

Empirical formula = P₂O₅

Molar mass of P₄O₁₀ = 4 × 31 + 10 × 16 = 124 + 160 = 284 g

[Important] Question: Indigo (C₁₆H₁₀N₂O₂), the dye used to colour blue jeans is derived from a compound known as indoxyl (C₈H₇ON). Calculate the molar masses of these compounds. Also write their empirical formulas.

Molar mass of Indigo (C₁₆H₁₀N₂O₂) = 16×12 + 10×1 + 2×14 + 2×16
= 192 + 10 + 28 + 32
= 262 g

Empirical formula of Indigo (C₁₆H₁₀N₂O₂) = C₈H₅ON

Molar mass of Indoxyl (C₈H₇ON) = 8×12 + 7×1 + 16 + 14
= 96 + 7 + 16 + 14
= 133 g

Empirical formula of Indoxyl (C₈H₇ON) = C₈H₇ON

Question: Identify the substance that has formula mass of 133.5 amu.

Formula mass of MgCl₂ = 24 + 2 × 35.5 = 24 + 71 = 95 amu

Formula mass of S₂Cl₂ = 2 × 32 + 2 × 35.5 = 64 + 71 = 135 amu

Formula mass of BCl₃ = 11 + 3 × 35.5 = 11 + 106.5 = 117.5 amu

Formula mass of AlCl₃ = 27 + 3 × 35.5 = 27 + 106.5 = 133.5 amu

Hence Formula mass of AlCl₃ is 133.5

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

[Very Important] Question: Calculate the number of atoms in each of the following samples.

3.4 moles of nitrogen atoms:

$$\begin{aligned} \text{Number of moles} &= 3.4 \text{ moles} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23} \\ \text{Number of atoms} &= \text{Number of moles} \times N_A \\ &= 3.4 \times 6.022 \times 10^{23} \\ &= 20.5 \times 10^{23} \\ &= 2.05 \times 10^{24} \text{ atoms} \end{aligned}$$

23g of Na:

$$\begin{aligned} \text{Mass in gram} &= 23 \text{ g} \\ \text{Molar mass of sodium (Na)} &= 23 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23} \\ \text{Mass in grams} &= \text{Number of atoms} \times \frac{\text{Molar Mass}}{N_A} \\ \text{Number of atoms} &= \frac{23}{23} \times 6.022 \times 10^{23} = 6.022 \times 10^{23} \text{ atoms} \end{aligned}$$

5g of H atoms:

$$\begin{aligned} \text{Mass in gram} &= 5 \text{ g} \\ \text{Molar mass of hydrogen (H)} &= 1 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23} \\ \text{Mass in grams} &= \text{Number of atoms} \times \frac{\text{Molar Mass}}{N_A} \\ \text{Number of atoms} &= \frac{5}{1} \times 6.022 \times 10^{23} = 30.1 \times 10^{23} \text{ atoms} \\ \text{Number of atoms} &= 3.01 \times 10^{24} \text{ atoms} \end{aligned}$$

[Very Important] Question: Calculate the mass of following.

3.24×10^{18} atoms of iron:

$$\begin{aligned} \text{Number of atoms} &= 3.24 \times 10^{18} \text{ atoms} \\ \text{Molar mass of iron (Fe)} &= 56 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23} \\ \text{Number of atoms} \times \text{Molar Mass} &= \text{Mass in grams} \\ \text{Mass in grams} &= \frac{3.24 \times 10^{18} \times 56}{6.022 \times 10^{23}} \\ &= \frac{181.44 \times 10^{18}}{6.022 \times 10^{23}} = 30.1 \times 10^{18-23} \\ \text{Mass in gram} &= 30.1 \times 10^{-5} \text{ g} = 3.01 \times 10^{-4} \text{ g} \end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

2 x 10¹⁹ molecules of nitrogen gas:

$$\begin{aligned}\text{Number of molecules} &= 2 \times 10^{19} \text{ atoms} \\ \text{Molar mass of nitrogen gas (N}_2\text{)} &= 2 \times 14 = 28 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23}\end{aligned}$$

$$\text{Mass in grams} = \frac{\text{Number of molecules} \times \text{Molar mass}}{N_A}$$

$$\text{Mass in grams} = \frac{2 \times 10^{19} \times 28}{6.022 \times 10^{23}} = \frac{56 \times 10^{19}}{6.022 \times 10^{23}}$$

$$\text{Mass in grams} = 9.3 \times 10^{19-23} = 9.3 \times 10^{-4}$$

1 x 10²⁵ molecules of water:

$$\begin{aligned}\text{Number of molecules} &= 1 \times 10^{25} \text{ molecules} \\ \text{Molar mass of Water (H}_2\text{O)} &= 2 \times 1 + 16 = 18 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23}\end{aligned}$$

$$\text{Mass in grams} = \frac{\text{Number of molecules} \times \text{Molar mass}}{N_A}$$

$$\text{Mass in grams} = \frac{1 \times 10^{25} \times 18}{6.022 \times 10^{23}} = \frac{18 \times 10^{25}}{6.022 \times 10^{23}}$$

$$\text{Mass in grams} = 2.99 \times 10^{25-23} = 2.9 \times 10^2$$

3 x 10⁶ atoms of Al:

$$\begin{aligned}\text{Number of atoms} &= 3 \times 10^6 \text{ atoms} \\ \text{Molar mass of Aluminium} &= 27 \text{ g} \\ \text{Avogadro's number} &= N_A = 6.022 \times 10^{23}\end{aligned}$$

$$\text{Mass in grams} = \frac{\text{Number of molecules} \times \text{Molar mass}}{N_A}$$

$$\text{Mass in grams} = \frac{3 \times 10^6 \times 27}{6.022 \times 10^{23}} = \frac{81 \times 10^6}{6.022 \times 10^{23}}$$

$$\text{Mass in grams} = 13.46 \times 10^{6-23} = 13.46 \times 10^{-16}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

[Very Important] Question: Identify branch of chemistry that deals the following examples

A cornstalk grows from a seed.

Biochemistry

Dynamite ($C_3H_5N_3O_9$) explodes to form a mixture of gases.

Inorganic chemistry

Purple iodine vapour appears when solid iodine is warmed.

Analytical chemistry

Gasoline (a mixture of hydrocarbons) fumes are ignited in an auto mobile engine.

Organic chemistry.

A silver article tarnishes in air.

Environmental chemistry.

Ice floats on water.

Physical chemistry.

Sulphur dioxide is the major source of acid rain.

Environmental chemistry, since acid rain is an environmental problem.

Many other light chlorinated hydrocarbons in drinking water are carcinogens.

Environmental chemistry.

In Pakistan most of the factories use wet process for the production of cement.

Industrial chemistry.

Carbon-14 is continuously produced in the atmosphere when high energy neutrons from space collide with nitrogen-14.

Nuclear chemistry.

Question: What mass of sodium metal contains the same number of atoms as 12.00g of carbon.

Avogadro's number = $N_A = 6.022 \times 10^{23}$

1 mole of sodium atom = 1 mole of carbon-12 = 6.022×10^{23} atoms.

Therefore 23g of sodium metal contains the same number of atoms as 12.00g of carbon.

Question: What mass of oxygen contains the same number of molecules as 42g of nitrogen.

1 mole of N = 14 g

3 mole of N = $3 \times 14 = 42g$

1 mole of O = 16 g

3 mole of O = $3 \times 16 = 48g$

Question: Calculate the mass of one hydrogen atom in grams.

Mass of 1 hydrogen atom = $\frac{\text{Atomic mass of hydrogen}}{\text{Avogadro's number}}$

$$\begin{aligned} \text{Mass of 1 hydrogen atom} &= \frac{1.008}{6.022 \times 10^{23}} = 0.1674 \times 10^{-23} \\ &= 1.674 \times 10^{-24} \text{ g} \end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

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Question: Calculate the number of H-atoms present in 18g H₂O.

Known mass of H₂O = 18g = 1 mole of H₂O = 6.022×10^{23} atoms.

Since one molecule of water has two atoms of hydrogen, therefore,

Number of hydrogen atoms in 18g of H₂O = $2 \times 6.022 \times 10^{23} = 1.204 \times 10^{24}$ atoms.

Question: Calculate the total number of atoms present in 18g H₂O.

Known mass of H₂O = 18 g = 1 mole of H₂O = 6.02×10^{23} atoms.

Since one molecule of water has two atoms of hydrogen; and one atom of oxygen.

Therefore, one molecule of water has total number of atoms = $2 + 1 = 3$ atoms.

Total number of atoms in 18g of water = $3 \times 6.02 \times 10^{23} = 1.806 \times 10^{24}$ atoms.

THEORY

Question: How do chemistry led to rapid progress in 19th century?

As 19th century began, John Dalton proposed an atomic theory. This theory led to rapid progress in chemistry.

Question: Define Chemistry.

Chemistry, is the branch of science, which deals with the composition, properties, chemical changes in matter and the laws and principles, which govern these changes.

Background:

The word Chemistry is derived from Kheem which is the ancient name of Egypt and the word Kheem was probably given to chemistry due to the black colour of the soil of Egypt. The Arabs named it Al-Kimya in their own language and in the English, it became Alchemy.

[Very Important] Question: Define the branches of Chemistry.

Physical Chemistry: -

It is the study of physical properties of material things.

Inorganic Chemistry: -

It is the study of all compounds except of carbon.

Organic Chemistry: -

It is the study of compounds of carbon.

Analytical Chemistry: -

It is the study of analytical methods for getting information about chemical compounds.

Bio Chemistry: -

It is the study of chemical compounds and their reactions occurring in living things.

Industrial Chemistry: -

It is the study of chemical knowledge in technology and preparation of industrial products.

[Very Important] Question: Give main postulates of Dalton's atomic theory?

Main postulates of Dalton atomic theory are as under:

- i) All elements are composed of tiny indivisible particles called atoms.

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CHEMISTRY FOR 9TH CLASS (UNIT # 1)

- =====
- ii) Atoms of a particular element are identical. They have same mass and same volume.
 - iii) During chemical reaction atoms combine or separate or re-arrange. They combine in simple ratios.
 - iv) Atoms can neither be created nor destroyed.

[Very Important] Question: What are the defects of Dalton's atomic theory?

Series of experiment that were performed in 1850's and beginning of 20th century clearly demonstrated that atom is divisible and consists of subatomic particles, electrons, protons and neutrons. Also the atoms of an element may differ in masses (such atoms are called isotopes). Thus some of the postulates of Dalton's atomic theory were found defective and were changed.

Question: Photosynthesis produces glucose and oxygen from carbon dioxide and water in presence of chlorophyll and sunlight. Identify the branch of chemistry in this case.

Biochemistry, since photosynthesis is a chemical reaction that occurs in plants (living organism).

Question: Plantation helps in overcoming green house effect. Identify the branch, of chemistry in this case.

Environmental chemistry, since green house effect is an environmental problem.

Haber's process converts large quantities of hydrogen and nitrogen into ammonia (NH₃). Identify the branch of chemistry in this case.

Industrial chemistry, since large scale production of any substance is the subject of industrial chemistry.

Question: Ammonia is a colourless gas with pungent irritating odour. It is highly soluble in water. Identify the branch of chemistry during this process.

Inorganic chemistry, since it deals with properties of inorganic compounds.

Question: A chemist performed an experiment to check the percentage purity of a sample of glucose (C₆H₁₂O₆). Identify branch of chemistry in this case.

Analytical chemistry, since it deals with analysis of a compound, whether organic or inorganic in nature.

Question: An analyst determines that NO₂ is responsible for acid rain. Identify the branch of chemistry in this case.

Environmental chemistry, since acid rain is an environmental problem.

Question: Chlorofluorocarbon compounds are responsible for the depletion of ozone layer. Identify the branch of chemistry in this case.

Environmental chemistry, since depletion of ozone layer is environmental problem.

Question: alpha-particles (He) when bombard on nitrogen atom, a proton is emitted. Identify the branch of chemistry in this case.

Nuclear chemistry, since nuclear change can emit protons.

Question: Define the followings:

Matter:

Anything that occupies space and has mass is called matter.

Mass:

Quantity of matter in a body, is called its mass.

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

Substance:

Matter that has a particular set of characteristics that differ from the characteristics of another kind of matter is called a substance.

Element:

An element is a substance whose all the atoms have the same atomic number.

Compound:

A compound consists of two or more elements held together in fixed proportions by chemical bonds.

Mixture:

An impure substance that contains two or more pure substances that retain their individual chemical characteristics is called a mixture. It has two types:

- **Heterogeneous** mixture consists of two or more visibly, different components
- **Homogeneous** mixture consists of only one phase.

[Very Important] Question: Write the two main advantages of garlic.

- Bad breath may be good for you. The chemistry of garlic is not simple.
- Garlic contains more than 200 compounds.
- People who eat a lot of garlic have a lower chance of getting stomach cancer, suffering from heart disease.

[Very Important] Question: Describe the classification of molecules?

Monoatomic molecules:

A molecule that contains only one atom is called monoatomic.

Polyatomic molecules:

Molecules that contain two or more similar or different atoms are called polyatomic molecules.

[Very Important] Question: Write the formation of Na⁺ ion?

Sodium has a nucleus of 11 protons and 12 neutrons. Thus its nucleus has a total charge of +11. Around the nucleus, in the ion are 10 electrons, with a total charge of -10. The charge on the ion is +11 + (-10) = +1

[Very Important] Question: Write the Empirical and Molecular Formulas of Aspirin and Vinegar.

Empirical formula of Aspirin is C₉H₈O₄.

Molecular formula of Aspirin is also C₉H₈O₄.

Empirical formula of Vinegar is C₂H₄O₂.

Molecular formula of Vinegar is CH₂O.

CHEMISTRY FOR 9TH CLASS (UNIT # 1)

List of Elements with Their Symbols and Atomic Masses

Element	Symbol	Atomic Number	Atomic Mass	Element	Symbol	Atomic Number	Atomic Mass
Actinium	Ac	89	(227)	Meitnerium	Mt	109	(266)
Aluminium	Al	13	26.98	Mendelevium	Md	101	(256)
Americium	Am	95	(243)	Mercury	Hg	80	200.6
Antimony	Sb	51	121.8	Molybdenum	Mo	42	95.94
Argon	Ar	18	39.95	Neodymium	Nd	60	144.2
Arsenic	As	33	74.92	Neon	Ne	10	20.18
Astatine	At	85	(210)	Neptunium	Np	93	(237)
Barium	Ba	56	137.3	Nickel	Ni	28	58.69
Berkelium	Bk	97	(247)	Niobium	Nb	41	92.91
Beryllium	Be	4	9.012	Nitrogen	N	7	14.01
Bismuth	Bi	83	209.0	Nobelium	No	102	(253)
Bohrium	Bh	107	(262)	Osmium	Os	76	190.2
Boron	B	5	10.81	Oxygen	O	8	16.00
Bromine	Br	35	79.90	Palladium	Pd	46	106.4
Cadmium	Cd	48	112.4	Phosphorus	P	15	30.97
Calcium	Ca	20	40.08	Platinum	Pt	78	195.1
Californium	Cf	98	(249)	Plutonium	Pu	94	(242)
Carbon	C	6	12.01	Polonium	Po	84	(210)
Cerium	Ce	58	140.1	Potassium	K	19	39.10
Cesium	Cs	55	132.9	Praseodymium	Pr	59	140.9
Chlorine	Cl	17	35.45	Promethium	Pm	61	(147)
Chromium	Cr	24	52.00	Protactinium	Pa	91	(231)
Cobalt	Co	27	58.93	Radium	Ra	88	(226)
Copper	Cu	29	63.55	Radon	Rn	86	(222)
Curium	Cm	96	(247)	Rhenium	Re	75	186.2
Darmstadtium	Ds	110	(281)	Rhodium	Rh	45	102.9
Dubnium	Db	105	(260)	Rubidium	Rb	37	85.47
Dysprosium	Dy	66	162.5	Ruthenium	Ru	44	101.1
Einsteinium	Es	99	(254)	Rutherfordium	Rf	104	(257)
Erbium	Er	68	167.3	Samarium	Sm	62	150.4
Europium	Eu	63	152.0	Scandium	Sc	21	44.96
Fermium	Fm	100	(253)	Seaborgium	Sg	106	(263)
Fluorine	F	9	19.00	Selenium	Se	34	78.96
Francium	Fr	87	(223)	Silicon	Si	14	28.09
Gadolinium	Gd	64	157.3	Silver	Ag	47	107.9
Gallium	Ga	31	69.72	Sodium	Na	11	22.99
Germanium	Ge	32	72.59	Strontium	Sr	38	87.62
Gold	Au	79	197.0	Sulfur	S	16	32.07
Hafnium	Hf	72	178.5	Tantalum	Ta	73	180.9
Hassium	Hs	108	(265)	Technetium	Tc	43	(99)
Helium	He	2	4.003	Tellurium	Te	52	127.6
Holmium	Ho	67	164.9	Terbium	Tb	65	158.9
Hydrogen	H	1	1.008	Thallium	Tl	81	204.4
Indium	In	49	114.8	Thorium	Th	90	232.0
Iodine	I	53	126.9	Thulium	Tm	69	168.9
Iridium	Ir	77	192.2	Tin	Sn	50	118.7
Iron	Fe	26	55.85	Titanium	Ti	22	47.88
Krypton	Kr	36	83.80	Tungsten	W	74	183.9
Lanthanum	La	57	138.9	Uranium	U	92	238.0
Lawrencium	Lr	103	(257)	Vanadium	V	23	50.94
Lead	Pb	82	207.2	Xenon	Xe	54	131.3
Lithium	Li	3	6.941	Ytterbium	Yb	70	173.0
Lutetium	Lu	71	175.0	Yttrium	Y	39	88.91
Magnesium	Mg	12	24.31	Zinc	Zn	30	65.39
Manganese	Mn	25	54.94	Zirconium	Zr	40	91.22

CHEMISTRY FOR 9TH CLASS (UNIT # 2)

REVIEW QUESTIONS

[Important] Distinguish between shell and sub-shell.

Shell:

- An electron shell is as an orbit followed by electrons around an atom's nucleus.
- The closest shell to the nucleus is called the "1 shell" or "K Shell".
- The shell letters K, L, M are alphabetical.
- Each shell can contain only a fixed number of electrons. For example 1 shell can hold two electrons and 2 shell can hold up to eight electrons.
- The formula to hold the electrons is $2n^2$.

Sub Shell:

- Each shell is composed of one or more sub-shells, which are themselves composed of atomic orbital.
- For example, the first (K) shell has one subshell, called "1s". the second (L) shell has two subshells, called "2s" and "2p" and so on.
- Sub-shells are labeled as s, p, d, f, g etc.

[Very Important] An atom is electrically neutral, why?

- Protons have a positive charge that is usually expressed as +1 though in terms of coulombs.
- It is $+1.602 \times 10^{-19}$ C.
- The electron has a negative charge that is expressed as -1 and in terms of coulombs is equal to -1.602×10^{-19} C.
- A neutral atom has the same number of electrons as the number of protons in it.
- Therefore the net charge in an atom is equal to zero.
- This makes an atom electrically neutral.

How many sub-shells are there in N shell.

Shell $n=4$ contains 4 sub shells, s, p, d and f (4s, 4p, 4d, 4f)

Give notation for sub-shells of M shell

Notation for M shell is $n=3$ So M shell has 3 sub-shells called 3s , 3p and 3d

List the sub-shells of M Shell in order of increasing energy

$3s < 3p < 3d$

Can you identify an atom without knowing number of neutrons in it?

Yes. By using the following formula we can identify an atom without knowing number of neutrons in it.

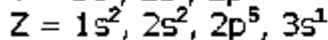
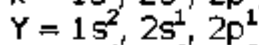
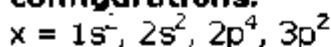
Number of neutrons = Atomic mass - Atomic Number = $A - Z$

Atomic number = Z = Number of protons = Number of electrons

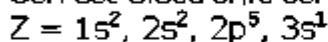
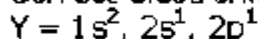
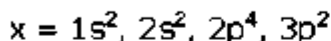
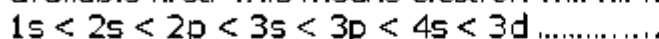
Atomic mass = A = Number of protons + Number of neutrons

CHEMISTRY FOR 9TH CLASS (UNIT # 2)

[Very Important] The electronic configurations listed are incorrect. Explain what mistake has been made in each and write correct electronic configurations.



According to **Auf Bau principle**, electrons fill the lowest energy sub-shell that is available first. This means electron will fill first 1s, then 2s, then 2p and so on.



Which orbital in each of the following pairs is lower in energy?

a. 2s, 2p

The energy of $2s < 2p$.

b. 3p, 2p

The energy of $2p < 3p$.

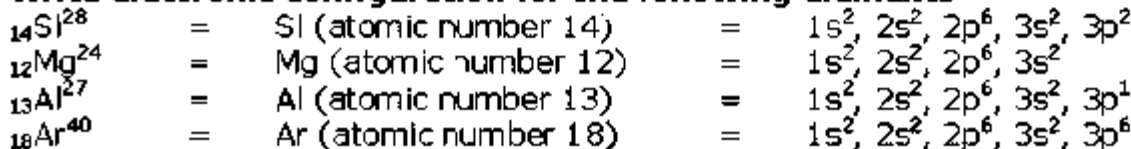
c. 3s, 4s

The energy of $3s < 4s$

Draw Bohr's Model for the following atoms indicating the location for electron, protons and neutron

a. Potassium (Atomic No. 19, Mass No. 39)	b. Silicon (Atomic No. 14, Mass No. 28)	c. Argon (Atomic No. 18, Mass No. 39)

Write electronic configuration for the following elements



CHEMISTRY FOR 9TH CLASS (UNIT # 2)

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[Very Important] Describe the contribution that Rutherford made to the development of the atomic theory.

In 1911 Rutherford performed an experiment in order to know the arrangement of electrons and protons in atoms.

Rutherford's experiment:

- Rutherford bombarded a very thin gold foil about 0.0004cm thickness with alpha particles.
- He obtained alpha particles from the disintegration of polonium.
- Alpha particles are helium nuclei that are doubly positively charged (He^{++}).
- Most of these particles passed straight through the foil.
- Only few particles were slightly deflected. But one in 1 million was deflected through an angle greater than 90° from their straight paths.
- Rutherford performed a series of experiments using thin foils of other elements. He observed similar results from these experiments.

Conclusion:

- Since majority of the alpha particles passed through the foil un-deflected, most of the space occupied by an atom must be empty.
- The deflection of few alpha particles through angles greater than 90° shows that these particles are deflected by electrostatic repulsion between the positively charged alpha particles and the positively charged part of atom.
- Massive alpha particles are not deflected by electrons.

Discovery of nucleolus:

- Rutherford proposed a planetary model (similar to the solar system) for an atom.
- An atom is neutral particle.
- The mass of an atom is concentrated in a very small dense positively charged region. He named this region as nucleus.
- A positively charged region is present at the centre of an atom and the electrons are revolving around the nucleus in circles.
- These circles are called orbits.
- The centripetal force due to the revolution of electrons balances the electrostatic force of attraction between the nucleus and electron.

Explain how Bohr's atomic theory different from Rutherford's atomic theory.

- Rutherford's atomic theory could not explain the stability of an atom and line spectrum for an atom.
- Bohr leaped over difficulty by using Quantum Theory of Radiation that was proposed by Max Plank.
- Bohr proposed that an electron moves around the nucleus in well defined circular paths called orbits.
- An orbit has fixed energy.
- Electron present in an orbit does not emit energy.
- Bohr atomic theory explains nicely the stability of an atom and also explains why an atom gives line spectrum

CHEMISTRY FOR 9TH CLASS (UNIT # 2)

Describe the presence of sub shells in a shell.

A shell or energy level is sub divided into sub-shells or sub-energy levels. The value of a shell is placed before the symbol for a sub-shell.

For Example:

- For K shell $n = 1$. It has only one sub-shell which is represented by 1s.
- For L shell $n = 2$. It has two sub-shells, these are designated as 2s and 2p.
- For M shell $n = 3$. It has 3 sub-shells called 3s, 3p and 3d.
- For N shell $n = 4$. It has 4 sub-shells called 4s, 4p, 4d, 4f

Note:

S sub-shell can accommodate maximum 2 electrons. P sub-shell can accommodate maximum 6 electrons. D sub-shell can accommodate maximum 10 electrons. F sub-shell can accommodate maximum 14 electrons.

The increasing order of energy of the sub-shells belonging to different shells is given below:

$$1s < 2s < 2p < 3s < 3p < 4s < 3d \dots\dots\dots$$

[Very Important] State the importance and uses of isotopes in various fields of life.

Stable and radioactive isotopes have many applications in science and medicines. Some of these are as follows:

- Iodine-131 is used as a tracer in diagnosing thyroid problem.
- Na-24 is used to trace the flow of blood and detect possible constrictions or obstructions in the circulatory system.
- Iodine-123 is used to image the brain.
- Cobalt-60 is commonly used to irradiate cancer cells in the hope of killing or shrinking the tumors.
- Carbon-14 is used to trace the path of carbon in photosynthesis.
- Radioactive isotopes are used to determine the molecular structure e.g. sulphur-35 has been used in the structure determination of thio-sulphate.
- Radioactive Isotopes are also used to study the mechanism of chemical reactions
- Radioactive isotopes are used to date rocks, soils, archaeological objects and mummies.

The atomic number of an element is 23 and its mass number is 56.

a) How many protons and electrons does an atom of this element have?

Atomic number = 23

Atomic mass = 56

Atomic number = Z = Number of protons = 23

Atomic number = Z = Number of electrons = 23

b) How many neutrons does this atom have?

Number of neutrons = Atomic mass - Atomic Number
= $A - Z$
= $56 - 23$
= 33 neutrons

CHEMISTRY FOR 9TH CLASS (UNIT # 2)

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The atomic symbol of aluminum is written as ${}_{13}\text{Al}^{27}$. What information do you get from it?

Atomic number = 13
Atomic mass = 27
Number of electrons = 13
Number of proton = 13
Number of neutron = 27 - 13 = 14
Distribution of electrons in different shells: K = 2, L = 8, M = 3

Aluminum has 3 electrons in its valence shell. Aluminum can loss 3 electrons to form Al^{+3} therefore aluminum is a metal.

How testing prevailing theories bring about changes in them?

When ideas of scientists are not correct, scientists did not discard their theory. Instead, they revised the theory to take into account new discoveries. This shows how testing prevailing theories bring about changes in them.

How experimental results of some scientists help chemist to formulate new theories and new explanation.

Definition To "Result":

Something that results-effect, consequence-beneficial or discernible effect-something obtained by calculation or investigation.

Definition To "Experimental":

A controlled procedure carried out discover or test something.

Example:

Bohr atomic theory explains nicely the stability of an atom and also explains why an atom gives line spectrum. Development of Bohr's atomic model explains how interpretations of experimental results of other scientists help chemists to formulate new explanations and new theories.

[Important] Two Isotopes of chlorine are ${}_{17}\text{Cl}^{35}$ and ${}_{17}\text{Cl}^{37}$. How do these Isotopes differ? How are they alike?

Difference:

- Mass Number of ${}_{17}\text{Cl}^{35}$ is 35 and ${}_{17}\text{Cl}^{37}$ is 37.
- No. of Neutrons in ${}_{17}\text{Cl}^{35}$ are 18 and in ${}_{17}\text{Cl}^{37}$ are 20.
- Neutral Abundance in ${}_{17}\text{Cl}^{35}$ is 75% and in ${}_{17}\text{Cl}^{37}$ is 25%
- Physical Properties of both are different.

Similarity:

- Both have 17 electrons.
- Both have 17 protons.
- Chemical properties of both are alike.
- Electronic Configuration of both are alike.

How many electrons can be placed in all of the sub-shells in n=2 shell?

When n = 2. it is L-shell. L-shell can accommodate $2(n)^2 = 2(2)^2 = 8$. L shell has 2 sub-shells i.e. s and p.

CHEMISTRY FOR 9TH CLASS (UNIT # 2)

=====

Mass number of an atom indicates total number of protons and neutrons in the nucleus. Can you identify an atom without any neutron?

Yes, ordinary hydrogen (Protium) has only 1 proton and 1 electron. Hydrogen has no neutron in its nucleus.

Naturally occurring nitrogen has two isotopes N-14 and N-15 which isotope has greater number of electrons.

Both the isotopes have the same number of electron because isotopes can differ in the number of neutrons.

[Very Important] What are the defects of Rutherford's model of atom?

- Classical Physics suggests that electron will emit energy continuously while revolving around the nucleus. Thus the orbit of the revolving electron becomes smaller and smaller until it would fall into the nucleus. This would collapse the atomic structure.
- If revolving electron emits energy continuously it should form a continuous spectrum for an atom but a line spectrum is obtained.

[Very Important] Question: Why Bohr's Atomic Model is better than Rutherford's Model? Give his postulates.

Rutherford's Model was defective and needs correction. To remove these defects, Bohr gave his atomic theory in 1913. This theory clearly explained the line spectrum obtained from hydrogen atom.

Postulates of Bohr's Atomic Theory:

- i) Electron revolves around the nucleus in fixed circular orbits called energy levels.
- ii) Higher the orbit, greater is its energy.
- iii) The electron can move only in orbits in which the angular momentum (mvr) of electron is integral multiple of $h/2\pi$.
- iv) As long as electron remains in a particular orbit, it does not radiate or absorb energy. When an electron jumps from lower energy level to a higher energy level it absorbs energy and when it jumps from higher energy level to a lower energy orbit it radiates energy.
- v) This energy emitted is exactly equal to the difference between the two energy levels.

[Important] How does the discovery of isotopes contradicted Dalton's atomic theory?

According to Dalton's atomic theory, "All atoms of the same element have the same mass".

Whereas isotopes are atoms of an element whose nuclei have the same atomic number but different mass number. This is because atoms of an element can differ in the number of neutrons. Thus the discovery of isotopes contradicted Dalton's atomic theory

[Important] Why isotopes of an element have similar chemical-properties?

Chemical properties of an element depend upon the number of protons and electrons. Neutrons do not take part in ordinary chemical reactions. Therefore, isotopes of an element have similar chemical properties.

CHEMISTRY FOR 9TH CLASS (UNIT # 3)

=====

Write the valence shell electronic configuration of an element present in the 3rd period and Group III-A.

Aluminum (Al):

K = $1s^2$
L = $2s^2, 2p^6$
M = $3s^2, 2p^1$ (Valence Shell)

Write two ways in which isotopes of an element differ.

- The number of neutrons in the nucleus.
- The atomic mass.
- Physical properties and the nuclear stability.

Which atom has higher shielding effect, Li or Na?

- The valence-shell electron of $_{11}\text{Na}$ experience less attraction from the nucleus due to the presence of 10 inner-shell electrons as compares to $_3\text{Li}$ having 2 inner shell-electrons.
- Na atoms will have greater shielding effect due to greater number of Inner shell electrons as compare to Li.

Explain why, Na has higher ionization energy than K?

- Ionization energy decreases from top to bottom in a group.
- The size of sodium (3 shells) is smaller than potassium (4 shells).
- Therefore Na has higher ionization energy than K (group I-A elements)

Alkali metals belong to s-block in the periodic table, why?

Groups I-A on the left side of the table, constitute s-Block because outer shell valence electrons of these elements are present in s-orbitals/sub shell.

Arrange the elements in each of the following groups in order of increasing ionization energy:

Li, Na, K

Ionization energy of Li > Ionization energy of Na > Ionization energy of K
(Group I-A Elements)

Cl, Br, I

Ionization energy of Cl > Ionization energy of Br > Ionization energy of I
(Group VII-A Elements)

Arrange the elements in each of the following in order of decreasing shielding effect

Li, Na, K

Shielding effect of Li < Shielding effect of Na < Shielding effect of K

Cl, Br, I

Shielding effect of Cl < Shielding effect of Br < Shielding effect of I

Cl, Br

Shielding effect of Cl < Shielding effect of Br

CHEMISTRY FOR 9TH CLASS (UNIT # 3)

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Specify which of the following elements you would expect to, have the greatest electron affinity. S, P, Cl

As we move from left to right across a period, the electron affinity generally increases. This is due to increase in nuclear charge and decrease in atomic radius, which binds the extra electron more tightly to the nucleus. Therefore Cl has greatest electron affinity as compared to S and P.

For normal elements, the number of valence electrons of an element is equal to the group number. Find the group number of the following elements.

(Note: This is not the answer, but method to find the group number of any element)

- Do Electronic Configuration
- Guess No. of Electrons in Valance Shell
- That will be the Group Number

Write the valence shell electronic configuration for the following groups

Alkali Metals:

ns^1 ,

Alkaline Earth Metals:

ns^2 ,

Halogens:

ns^2, np^5 ,

Noble Gases:

ns^2, np^6 ,

Imagine you are standing on the top of Neon-20 nucleus. How many kinds of sub- atomic particles you would see looking down into the nucleus and those you would see looking out from the nucleus.

Sub atomic particles present inside the nucleus of Neon-20 are:

Number of protons = 10

Number of neutrons = $A - Z$ = $20 - 10 = 10$

Sub atomic particles present outside the nucleus of Neon-20 are:

Number of electrons = 10

What types of elements have the highest ionization energies and what types of elements have the lowest ionization energies.

Noble gases (group VIII-A) have the highest ionization energies because they have complete outer most shells (follows octet or duplet rule). Therefore it is difficult to remove an electron from their outer most shell.

On the other hand Alkali metals (group I-A) have greater size, therefore Alkali metals have lowest ionization energy.

Two atoms have electronic configuration $1s^2, 2s^2, 2p^6$ and $1s^2, 2s^2, 2p^6, 3s^1$. The ionization energy of one is 2080KJ/mole and that of the other is 496 KJ/mole. Match each ionization energy with one of the given electronic configuration. Give reason for your choice.

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CHEMISTRY FOR 9TH CLASS (UNIT # 3)

- =====
- Noble gases (group VIII-A) have the highest ionization energies because they have complete outer most shells (follows octet or duplet rule). Therefore it is difficult to remove an electron from their outer most shell. Therefore in this case the value of ionization energy will be 20801 KJ/mol.
 - The electronic configuration $2s^2, 2p^6, 3s^1$ (Na) shows the alkali metals (Group I-A). Alkali metals (group I-A) have greater size, therefore Alkali metals have lowest ionization energy. Therefore in this case the value of ionization energy will be 496 KJ/mol

Use the second member of each group from Group I-A, II-A and VII-A to show that the number of valence electron on an atom of the element is the same as its group number.

- Second member of group I-A is (Li). Valance shell configuration of lithium is $2S^1$. Here valance electron of Lithium is 1 therefore its group number is also I-A.
- Second member of group II-A is (Mg). Valance shell configuration of magnesium is $3S^2$. Here valance electrons of magnesium are 2 therefore its group number is also II-A.
- Second member of group VII-A is (Cl). Valance shell configuration of chlorine is $3s^2, 3p^5$ Here valance electrons of chlorine are $2+5=7$ therefore its group number is also VII-A.

In what region of the periodic table you will find elements with relatively a) High ionization energies, b) Low ionization energies:

a) High ionization energies:

Noble gases (group VIII-A) have the highest ionization energies because they have complete outer most shells (follows octet or duplet rule), therefore it is difficult to remove an electron from their outer most shell. Therefore, elements in the upper right of the periodic table have the highest ionization energy, (Noble gases, p-block)

b) Low ionization energies:

On the other hand Alkali metals (group I-A) have greater size, therefore Alkali metals have lowest ionization energy. Therefore, elements in the upper left of the periodic table have the lowest ionization energy, (Alkalies metals, s-block).

Define periodic table. What is the basis of the classification of elements in the modern periodic table?

A table showing systematic arrangement of elements is called periodic table. It is based on the Periodic law that states if the elements are arranged in the order of their increasing atomic numbers, their properties are repeated in a periodic manner.

Today how much elements are listed in the periodic table?

By the end of 18th century, 23 elements are known, by 1870, 65 by 1925, 88, today there are 109.

CHEMISTRY FOR 9TH CLASS (UNIT # 3)

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Give the significance/advantages of periodic table?

- The periodic table is one of the most important tools in chemistry.
- It is very useful for understanding and predicting the properties of the elements.
- For instance if you know physical and chemical properties of one element in a group, you can predict about the physical and chemical properties of any other element present in the same group.
- We can use periodic table to relate trends in the reactivity of elements with their atomic structure.
- We can also predict which elements can form ionic or covalent bonds.

Define period. How many periods are there in the long form of periodic table?

- The horizontal rows of the periodic table are called periods. There are seven periods.
- First three periods are called short periods and the remaining periods are called long periods.

What do you mean by group or family in the periodic table?

- Elements that have similar properties lie in the same column in the periodic table.
- Each vertical column of elements in the periodic table is called a group or family.

What are the representative and transition elements?

Normal elements:

- Group A elements are called normal or representative elements. They are also called main group elements
- All s-block and p-block elements excluding the noble gases are called representative or main group elements.

Transition elements:

- The d-block elements are called transition elements or outer transition elements.
- These elements occupy group 3 to 12 of the periodic table and lie in between the s- and p-block elements.
- The f-block elements are called inner-transition elements.

What was the concept of John Newland.

- In 1864, John Newland an English chemist arranged 24 elements in order of increasing atomic masses.
- He noticed that every eighth element starting from any point has similar properties.
- His scheme however, failed because many elements were found out of place in his arrangement

What was concept of Mendeleev?

- In 1869, Mendeleev a Russian chemist developed a classification scheme of elements.
- He recognized that if elements were placed in order of increasing atomic masses, the properties of elements repeated at regular intervals.
- He arranged 65 elements in periods and groups.

CHEMISTRY FOR 9TH CLASS (UNIT # 3)

What is meant by the periodicity of properties?

- The electronic configuration of the elements shows a periodic variation with the increasing atomic number.
- Therefore, the elements also show periodic variation in their physical and chemical properties.
- Elements having similar valence shell electronic configuration have been placed in the same group, one below the other.

Periodicity in Chemical properties:

- Chemical properties depend on the valence shell electronic configuration.
- Because all the elements of a particular group have similar valence shell electronic configuration, they possess similar chemical characteristics.

Periodicity in Physical properties:

- Physical properties depend on the sizes of atoms.
- Since sizes of atoms change gradually from top to bottom in a group.
- Therefore, elements show gradation in physical properties in the same group.
- In a period of periodic table the number of electrons present in the valence shell increase gradually from left to right.
- Their chemical and physical properties also show variation in the same manner.

How does the shielding effect influence the atomic size, ionization energy and electron affinity? Justify that shielding effect increases down the group, and remains constant in a period from left to the right.

Variation of shielding effect in a group:

- As we move from top to bottom in a group the number of electronic shells increase.
- So the number of electrons in the inner shell also increase.
- As a result shielding effect increases. , '

Variation of shielding effect in a period:

- When we travel from left to the right in the periodic table in a period then number of shells remain the same.
- So the shielding effect does not change in a period.

Influence of shielding effect on atomic size:

- Greater is the atomic size, greater will be the shielding effect.
- As the force of attraction between the nucleus and outer electron decreases with the increases in distance.
- The electron can be removed more easily with less energy.
- Moreover the force of attraction also decreases with the increasing shielding effect of the intervening electron.

Influence of shielding effect on ionization energy:

- Shielding effect depends upon the inner shell electrons.
- If the inner shell electrons are greater, shielding effect will be high and force of attraction between valence shell and nucleus will be low.
- In a group, number of shells increases from top to bottom and shielding effect also increases.
- The atoms with high shielding effect have low ionization energies.

CHEMISTRY FOR 9TH CLASS (UNIT # 3)

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Influence of shielding effect on electron affinity:

- In groups, the atomic radius increases with the increase in the proton number due to successive increase of electronic shell which also exert a shielding effect on the force of attraction between the nucleus and the valence electrons.
- Thus, the electron affinities usually decrease from top to bottom.
- There are, of course, exceptions to this generalization e.g. fluorine has electron affinity less than that of chlorine because it has a smaller atomic size than that of chlorine.

Define electro negativity. Name the most electronegative element and discuss its variation in groups and periods.

Electro negativity is the ability of an atom to attract the electrons towards itself in a chemical bond. The American chemist Linus Pauling devised a method for calculating relative electro negativities of elements.

Most electronegative element:

- Pauling assigned maximum value of 4.0 to the electro negativity of fluorine (F).
- The least electronegative element is cesium (Cs) and its electronegative value is 0.7

Variation in a group:

- Electron negativity of elements decreases from top to bottom in a group.
- This is because an increase in the atomic size decreases the tendency to attract the shared pair of electrons.

Variation in a period:

- The electro negativity increases from left to right in a period.
- The nuclear charge increases from left to right while the electrons enter the same shell.
- The electrons in the same shell cannot shield each other effectively from the attractive force of the nucleus. Hence, the increased nuclear charge attracts the shared pair of electrons more strongly.
- This results in higher electro negativity.

CHEMISTRY FOR 9TH CLASS (UNIT # 4)

State- octet and duplet rules.

Octet rule:

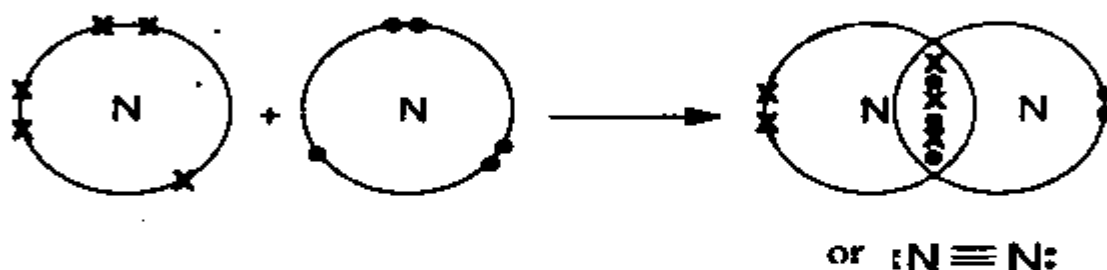
- The tendency of atoms to acquire eight electron configurations in their valence shell, is called octet rule.
- Each noble gas (except He) has eight electrons in their valence shell.

Duplet rule:

- The tendency of some atoms to acquire two electron configurations in their valence shell is called duplet rule.
- Helium has two electrons in its valence shell and is also chemically inert.
- Some other elements also tend to achieve two electron configurations in their valence shell. For example Hydrogen, Lithium etc.

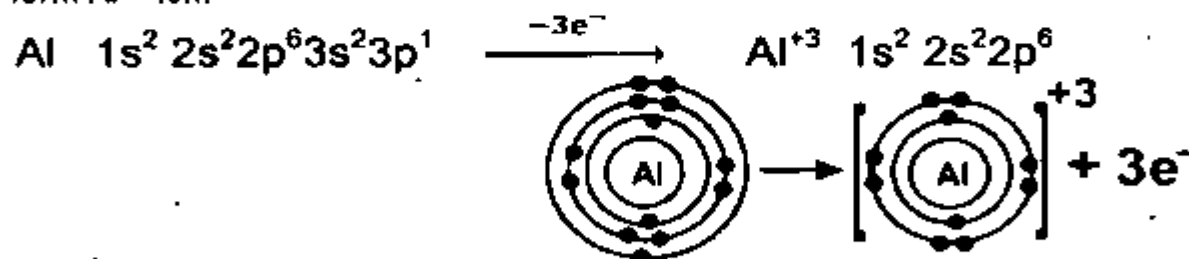
Explain formation of covalent bond between two nitrogen atoms.

- Nitrogen is in Group V-A, so it has 5 electrons in the valence shell.
- It needs three electrons to complete its octet.
- So for sharing each N-atom contributes three electrons.



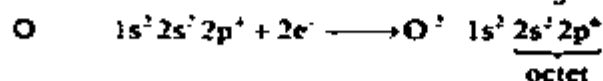
How does Al form cations?

Since Al atom has three electrons in the outer most shell, it loses three electrons to form Al^{+3} ion.

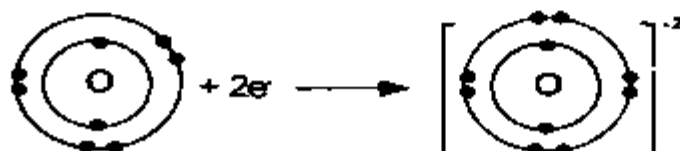


How does Oxygen form anion?

Oxygen belongs to Group VI-A on the periodic table, so it has six electrons in its valence shell. It needs two electrons to achieve noble gas configuration.



You can also represent this by electron dot structure.

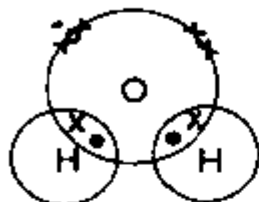


CHEMISTRY FOR 9TH CLASS (UNIT # 4)

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Draw electron cross and dot structure for H₂O molecule.

- O has six valence electrons and each hydrogen atom has one valence.
- So O-atom needs two electrons to complete octet. Each H needs one electron to complete duplet.



Describe the importance of noble gas electronic configuration.

- Noble gases usually not combine to other elements or themselves.
- It is due to their electronic configuration.
- He has 2 valence electrons while other elements (Ne, Ar, Kr, Xe, Rn) have 8 valence electrons.
- In all noble gases their valence shell is completely filled.

Explain how elements/atoms attain stability?

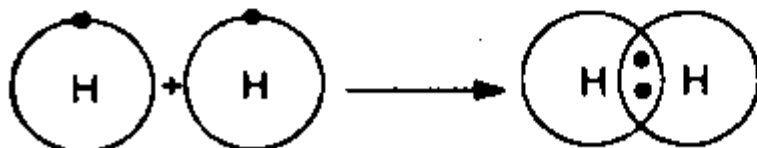
- An atom gains stability by having 8 electrons in its outer shell or 2 in some cases.
- It can do this through covalent bonding, or ionic bonding etc.
- If an element has less than 8 electrons it is unstable, and it gets stability by losing, gaining or sharing electrons.

Describe the ways in which bonds may be formed.

- The two types of bonds are formed between atoms. Ionic and Covalent.
- An ionic bond is formed when one atom accepts or donates one or more of its valence electrons.
- A covalent bond is formed when atoms share valence electrons.
- The atoms do not always share the electrons equally, so a **polar covalent** bond may be the result.
- When electrons are shared by two metallic atoms a **metallic bond** may be formed.

Describe the formation of covalent bond between two non-metallic elements.

Consider the formation of covalent bond in hydrogen molecule. A hydrogen atom has a single valence electron. Two hydrogen atoms share their valence electrons to form a di-atomic molecule.



In the formation of this molecule, each hydrogen atom achieves the electron configuration of the noble gas, helium which has two valence electrons.

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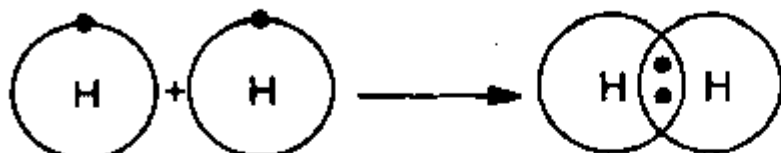
CHEMISTRY FOR 9TH CLASS (UNIT # 4)

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Explain with examples single, double and triple covalent bond.

Formation of single covalent bond in hydrogen molecule:

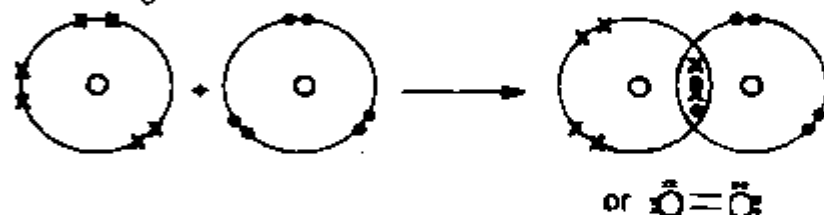
- Single covalent bonds are the bonds that are formed by sharing of one electron pairs.
- Consider the formation of covalent bond in hydrogen molecule. A hydrogen atom has a single valence electron. Two hydrogen atoms share their valence electrons to form a di-atomic molecule.



- In the formation of this molecule, each hydrogen atom achieves the electron configuration of the noble gas, helium which has two valence electrons.

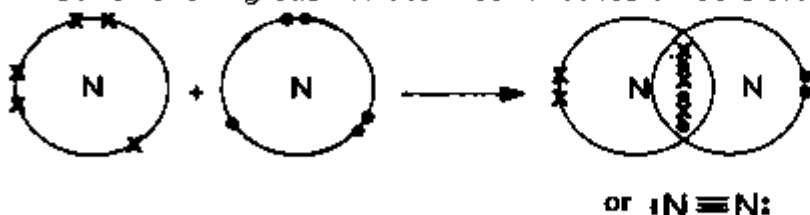
Formation of double covalent bond between two oxygen atoms:

- Double covalent bonds are the bonds that are formed by sharing of two electron pairs.
- Consider the formation of O₂ molecule. Oxygen is in Group VI-A, so it has 6 electrons in the valence shell. It needs two electrons to complete its octet. So for sharing each O-atom contributes two electrons.



Formation of triple covalent bond between two nitrogen atoms:

- Triple covalent bonds are the bonds that are formed by sharing of three electron pairs.
- Consider the formation of N₂ molecule, Nitrogen is in Group V-A, so it has 5 electrons in the valence shell. It needs three electrons to complete its octet.
- So for sharing each N-atom contributes three electrons.



Find the number of valence electrons in the following atoms using the ionic table.

- **Boron** (3 electrons group III-A element).
- **Neon** (8 electrons group VIII-A element)
- **Rubidium** (1 electron group I-A element)
- **Barium** (2 electrons group II-A element)
- **Arsenic** (5 electrons group V-A element)

CHEMISTRY FOR 9TH CLASS (UNIT # 4)

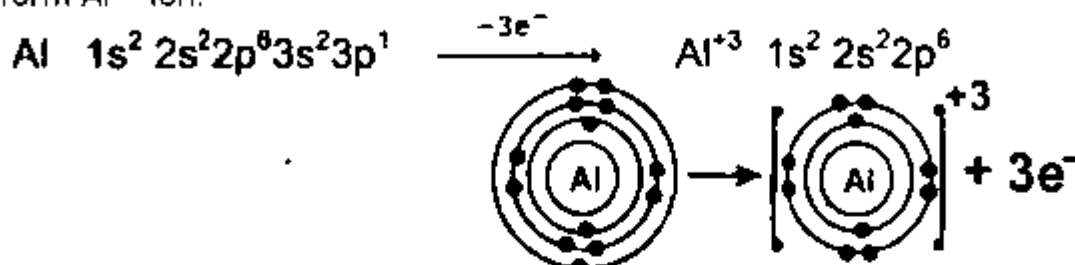
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Represent the formation of cations for the following metal atoms using electron dot structures.

Al^{+3} , Sr^{+2} , Ba^{+2}

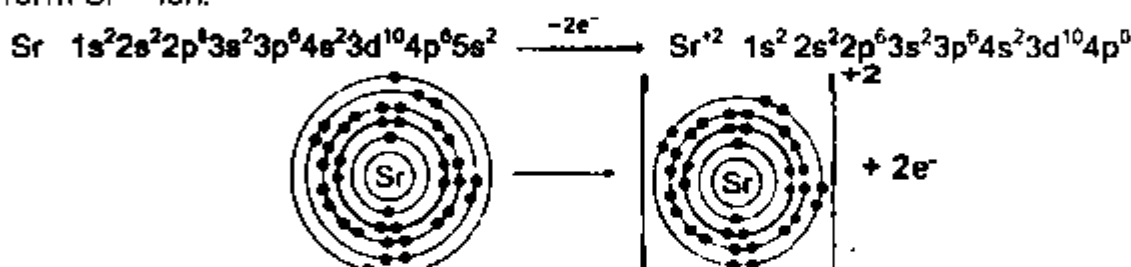
Formation of Al^{+3} ion: (Atomic number of Aluminum = 13)

Since Al atom has three electrons in the outer most shell. It loses three electrons to form Al^{+3} ion.



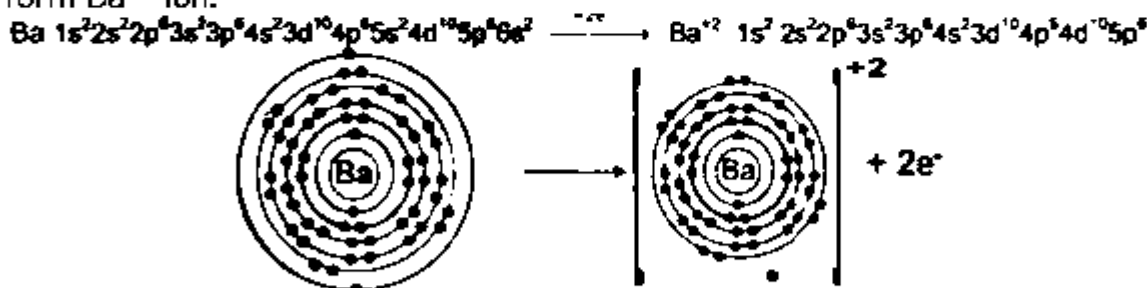
Formation of Sr^{+2} ion: (Atomic number of strontium = 38)

Since Sr atom has two electrons in the outer most shell. It loses two electrons to form Sr^{+2} ion.



Formation of Ba^{+2} ion: (Atomic number of barium = 56)

Since Ba atom has two electrons in the outer most shell. It loses two electrons to form Ba^{+2} ion.



Describe the formation of anions for the following non-metal atoms. P, Br, H

Formation of P^{-3} anion:

Since P atom has five electrons in outermost shell, it needs three electrons to complete octet. So it gains three electrons to form P^{-3} ion

Formation of Br^{-1} anion:

Since Br atom has seven electrons in outermost shell, it needs one electron to complete octet. So it gains one electron to form Br^{-1} ion.

Formation of H^{-1} anion:

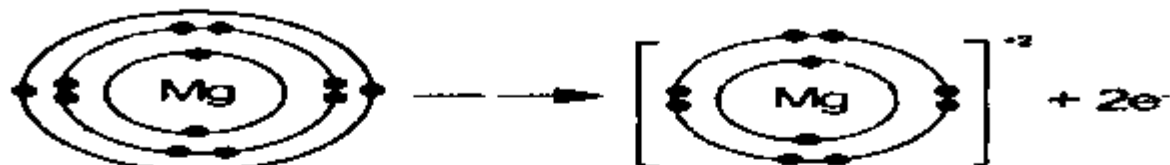
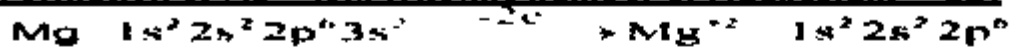
Since H atom has one electron in outermost shell, it needs one electron to complete duplet. So it gains one electron to form H^{-1} ion.

CHEMISTRY FOR 9TH CLASS (UNIT # 4)

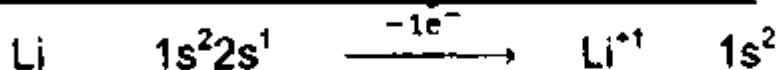
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Represent the formation of cations for the following metal atoms using electron dot structures. A) Mg b) Li c) Be

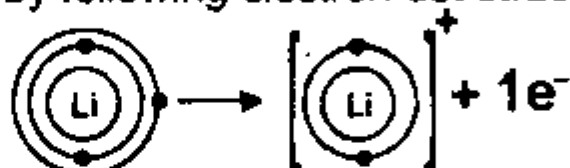
Formation of Mg⁺² ion. (Atomic number of Magnesium = 12)



Formation of Li⁺ ion. (Atomic number of lithium = 3)



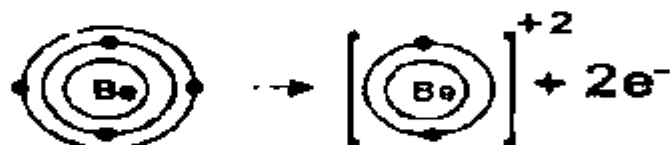
We can also represent Li⁺¹ by following electron dot structure.



Formation of Be⁺² ion. (Atomic number of Beryllium = 4)

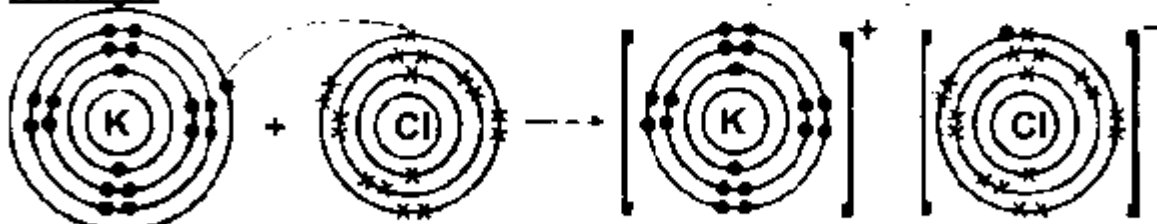


We can also represent Be⁺² by following electron dot structure.



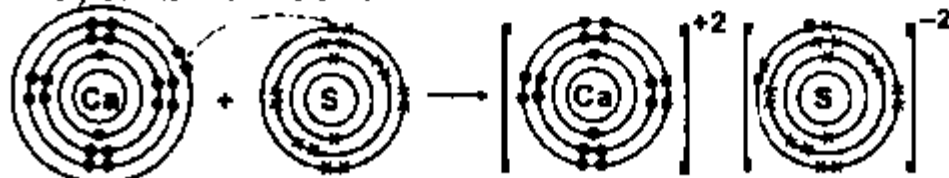
For each of the following pairs of atoms, use electron dot and electron cross structures to write the equation for the formation of ionic compound.

K and Cl:



Ca and S:

For every Ca⁺² ion we need S⁻² ions.



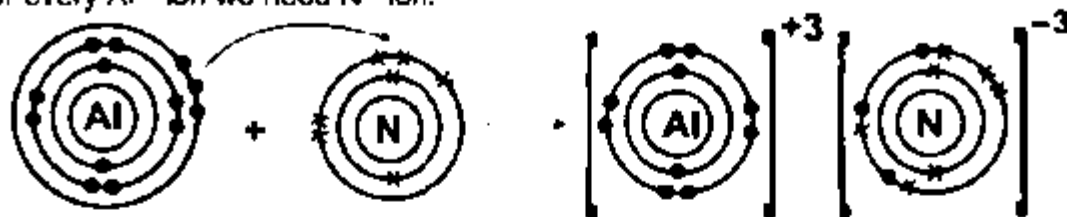
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CHEMISTRY FOR 9TH CLASS (UNIT # 4)

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Al and N:

For every Al^{+3} ion we need N^{-3} ion.



Is there a need for more adhesives?

Yes, there is a need for more adhesive. The adhesive action of paints and dyes is developed due to hydrogen bonding.

What is the importance of glues and adhesives in our society?

- An adhesive or stick on is a material (natural or synthetic) that adheres or bonds items together.
- Adhesives cure (harden) by either evaporating a solvent or by chemical reactions that occur between two or more constituents.
- Adhesives are advantageous for joining thin or dissimilar materials, minimizing weight, and when a vibration-damping joint is needed.
- A disadvantage of most adhesives is that most do not form an instantaneous joint, unlike many other joining processes, because the adhesive needs time to cure.
- Resins are widely used to paint dams, bridges, buildings and automobiles.

Why do atoms react?

All atoms (except for the noble gases) are unstable because their outer electron shell is not completely filled. Atoms react with other atoms to gain or lose electrons to fill their outer shell.

Define chemical bond?

The chemical force which keeps the atoms together is commonly described as a chemical bond.

Define dipole-dipole interactions. What is the nature of these linkages?

Slightly negative end of polar molecule is weakly attracted to the slightly positive end of another molecule. Such attracting forces are called dipole-dipole interactions. These linkages are weak and temporary.

What is Hydrogen bonding?

The interaction of a highly electron deficient hydrogen and lone pair on a nearby highly electronegative atom such as N, O or F is called hydrogen bond. This phenomenon is called hydrogen bonding.

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

REVIEW QUESTION

Explain why volume of a gas decreases on increasing pressure on it at constant temperature?

There are large empty spaces between the molecules. On increasing pressure on the gas, the distance between molecules decreases. So the volume of the gas decreases.

How does temperature effect vapour pressure of a liquid?

The vapour pressure of a liquid increases as the temperature increases. The molecules in the liquid are more energetic at higher temperatures, and more molecules can escape from the liquid phase into the gas phase.

Water boils at 120°C in a pressure cooker, why?

Pressure cooker has valve to controls the pressure. This valve exerts a pressure of 2 atm. Therefore, the valve does not allow water vapours to escape until the pressure inside the pot reaches 2 atm. Because vapour pressure of water becomes 2 atm when the temperature reaches 120°C. So water boils at 120°C in a pressure cooker.

Is evaporation a cooling process?

According to kinetic theory, the temperature is a measure of average kinetic energy of the molecules of a liquid. During evaporation, the escape of high energy molecules from the surface of a liquid, lowers the average kinetic energy of the remaining molecules and therefore, the temperature of the liquids falls down. Thus evaporation is a cooling process.

Can you make water boil at 70°C?

Yes, when the pressure of atmosphere is 1 atm, water boils at 100°C at sea level. So water boils at this height above sea level, when its vapour pressure is 34kPa at 70°C.

Express the pressure 400 mm Hg in kPa?

$$\begin{aligned} 1 \text{ atm} &= 760 \text{ mm} = 101.325 \text{ kPa} = 1.01325 \times 10^5 \text{ Pa} \\ 760 \text{ mm} &= 1.01325 \text{ kPa} \\ 1 \text{ mm} &= 1.01325/760 \\ 400 \text{ mm} &= 1.01325/760 \times 400 = 0.533 \text{ kPa} \end{aligned}$$

Explain the effect on the volume of a gas by a change in the (a) pressure (b) temperature.

Effect of pressure change on the volume of gas:

There are large empty spaces between the molecules. On increasing pressure on the gas, the distance between molecules decreases. So the volume of the gas decreases.

Effect of temperature change on the volume of gas:

When pressure of the gas is kept constant and temperature is increased, the average kinetic energy of gas molecules increases. So, the molecules of the gas hit the wall of the container more frequently and energetically. This increases internal pressure. As a result, volume of the gas increases to restore constant pressure.

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

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Explain the following properties of gases (a) Diffusion (b) Effusion

Diffusion:

- The movement of molecules from higher concentration to lower is called diffusion.
- Diffusion takes place in all directions.
- For example the smell of rose or a scent spread due to diffusion.

Effusion:

- The escape of gas molecules through the hole one after the other without collision is called effusion.
- Effusion takes place through a hole of molecular size.
- For example escape of gas molecules from punctured tyre.

Explain the following terms.

Evaporation:

- Conversion of a liquid to a gas or vapour at all temperatures is called vaporization or evaporation.
- Place some liquid (i.e. ether) in an open container and observe.
- You will notice that the volume of the liquid gradually decreases and finally no more of the liquid is left.
- This is because liquids constantly change into gas or vapours.
- According to kinetic theory, the temperature is a measure of average kinetic energy of the molecules of a liquid. During evaporation, the escape of high energy molecules from the surface of a liquid, lowers the average kinetic energy of the remaining molecules and therefore, the temperature of the liquids falls down. Thus evaporation is a cooling process.

Vapour pressure:

- The pressure exerted by the vapours of a liquid in equilibrium with its liquid is called vapour pressure.
- In a closed container no molecules can escape into the outside air, when a partially filled container is sealed.
- Some of the liquid molecules vapourize.
- As the time passes, the number of molecules changing into vapours increases.
- Some of these molecules because of their random motions will collide with the liquid surface.
- Such molecules are recaptured by the molecules at the surface of the liquid. This process is called condensation.
- These two opposing processes will continue. After some time, the number of molecules evaporating will become equal to the number of molecules condensing.
- At this stage equilibrium is established between the liquid and its vapours.

Boiling point:

- The temperature at which vapour pressure of a liquid becomes equal to the external or atmospheric pressure is called boiling point.
- Vapour pressure of the liquid keeps on increasing with the increase in temperature.
- At a certain temperature, the vapour pressure of the liquid becomes equal to the atmospheric pressure or external pressure.
- At this stage liquid starts boiling.

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

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Explain the effect of external pressure on boiling point.

- Liquids boil when their vapour pressure is equal to the pressure exerted on the liquid by its surroundings.
- The normal boiling point of water is 100°C.
- In the mountains the atmospheric pressure is less than 1 atm, so water boils below 100°C.
- Pressure cooker has valve to controls the pressure. This valve exerts a pressure of 2 atm. Therefore, the valve does not allow water vapours to escape until the pressure inside the pot reaches 2 atm. Because vapour pressure of water becomes 2 atm when the temperature reaches 120°C. So water boils at 120°C in a pressure cooker.

Differentiate between amorphous and crystalline solids.

- The solids in which atoms, molecules or ions are arranged in a regular repeating three-dimensional well ordered pattern are called as crystalline solids.
- Amorphous solids are those in which atoms, ions or molecules are not arranged in a definite pattern, rather these are randomly arranged.

What are allotropes? Explain the allotropic form of any two solids .

The different forms of an element in the same physical state and phase are called allotropic form or allotropes.

Diamond:

In diamond each carbon atom is bonded to four others, creating a rigid compact array. This makes diamond the hardest known substance.

Graphite:

In graphite carbon atoms are arranged in layers of hexagonal arrays. Weak bonds exist between the layers that allow them to slide over one another. This makes graphite soft.

Find the boiling point of each liquid when the atmospheric pressure is 1 atm.

<u>Name of Liquid</u>	<u>Boiling point</u>
Chloroform	61°C
Ethanol	78 °C
Water	100 °C
Ethanoic Acid	119 °C

At what temperature ethanol will boil when the atmospheric pressure is 51 kPa.

At 101.3 kPa pressure, Ethanol boils	=	78°C
At 1 kPa pressure, Ethanol boils	=	78/101.3
At 51 kPa pressure, Ethanol boils	=	78/101.3 x 51
	=	39.274°C

How can you make water to boil at 80°C?

The boiling point of water is 100°C when pressure is 760 mm Hg or one atm pressure.

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

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At 100°C pressure of water = 760 mm Hg
 At 1°C pressure of water = 760/100
 At 80°C pressure of water = 760/100 x 80
 = 608 mm Hg

So we can boil water at 80°C when pressure will be 608 mm Hg or 0.8 atm.

At what temperature chloroform will boil when the external pressure is 50 kPa.

When external pressure is 101.3 kPa than B.P of chloroform = 61°C.
 When external pressure is 1 kPa than B.P of chloroform = 61/101.3
 When external pressure is 50 kPa than B.P of chloroform = 61/101.3 x 50
 = 30.11°C

So, chloroform boils at 30.11°C when the external pressure is 50 kPa.

Can you boil chloroform at 0°C.

Yes. As temperature in °C can be changed into Kelvin scale.

Chloroform boils at 61°C = 273 + 61 = 334°K and 0 °C = 273°K

At 334°K temperature pressure on chloroform = 101.3 kPa
 At 1°K temperature pressure on chloroform = 101.3/334
 At 273°K temperature pressure on chloroform = 101.3/334 x 273
 = 82.82kPa

Thus when pressure is reduce to 82.82 kPa, chloroform boils at: 273°K (0°C).

Predict the boiling point of chloroform at 600 mm Hg.

Since 1 atm = 760 mm = 101.325 kPa .

When 760 mm Hg pressure then boiling point of chloroform = 61°C.
 When 1 mm Hg pressure then boiling point of chloroform = 61/760
 When 600 mm Hg pressure then boiling point of chloroform = 61/760x600
 = 48.16°C

Therefore boiling point of chloroform is 48.1°C at 600 mm Hg.

The air in a perfectly elastic balloon occupies 885 cm³ during the fall when the temperature is 20°C. During the winter, the temperature on a particular day is -10°C, the balloon occupies 794.39 cm³. If the pressure remains constant show that the given data proves the volume temperature relation according to the Charles's Law

- According to the Charles's law, ratio of volume to absolute temperature is constant for any set of conditions.
- Convert 0°C temperature to Kelvin temperature by adding 273.
- Find V/T for each set of conditions and compare.

Temperature (°C)	Volume	Temperature (K)	V/T
20	885	293	885/293 = 3.0204
-10	794.39	263	794.39/263 = 3.0204

The ratio V/T = 3.0204 is fairly constant. Thus volume of the gas varies directly with the absolute temperature as stated by the Charles's law.

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

In the past, gas volume was used as a way to measure temperature using devices called gas thermometers. An experimenter obtains following data from as thermometer.

Volume	Temperature
2.7	0°C
3.7	100 °C
5.7	300 °C

Show that gas thermometer obtained results according to Charles's law

- According to the Charles's law, ratio of volume to absolute temperature is constant for any set of conditions.
- Convert 0°C temperature to Kelvin temperature by adding 273.
- Find V/T for each set of conditions and compare

Temperature (°C)	Volume	Temperature (K)	V/T
0	2.7	273	2.7/273 = 0.0099
100	3.7	373	3.7/373 = 0.0099
300	5.7	573	5.7/573 = 0.0099

The ratio V/T = 0.0099 is fairly constant. Thus volume of the gas varies directly with the absolute temperature as stated by the Charles's law.

In automobile engine the gaseous fuel-air mixture enters the cylinder and is compressed by a moving piston before it is ignited. If the initial cylinder volume is 990 cm³. After the piston moves up, the volume is 90 cm³. The fuel-air mixture initially has a pressure of 1.0 atm and final pressure 11.0 atm. Do you think this change occurs according to the Boyle's law?

- According to the Boyle's law, product of pressure and volume is constant at any two sets of conditions.
- Calculate P x V for the two sets of condition and compare. (1 dm = 1000 cm³)

$$P_1 \times V_1 \text{ before change} = 1 \times \text{atm} \times 990/1000 \text{ dm}^3 = 0.99 \text{ atm.dm}^3$$

$$P_2 \times V_2 \text{ after change} = 11 \text{ atm} \times 90/1000 \text{ dm}^3 = 0.99 \text{ atm.dm}^3$$

$$\text{So it is proved that } P_1 \times V_1 = P_2 \times V_2$$

Thus the calculated result agrees with the pressure-volume relationship according to the Boyle's Law.

A sample of neon that is used in a neon sign has a volume of 1500 cm³ at a pressure of 636 torr. The volume of the gas after it is pumped into the glass tube of the sign is 1213.74 cm³ when it shows a pressure of 786 torr. Show that this data obeys Boyle's law

- According to the Boyle's law, product of pressure and volume is constant at any two sets of conditions.
- Calculate P x V for the two sets of condition and compare.
- (1 dm = 1000 cm³) and (a atm = 760 torr)

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

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$$\begin{aligned}P_1 \times V_1 \text{ before change} &= 636/760 \times \text{atm} \times 1500/1000 \text{ dm}^3 = 0.8368 \times \text{atm} \times 1.5 \text{ dm}^3 \\&= 1.255 \text{ atm.dm}^3 \\P_2 \times V_2 \text{ after change} &= 786/760 \times \text{atm} \times 1213.74/1000 \text{ dm}^3 = 1.0342 \times \text{atm} \times 1.21374 \text{ dm}^3 \\&= 1.255 \text{ atm.dm}^3\end{aligned}$$

So it is proved that $P_1 \times V_1 = P_2 \times V_2$

Thus the calculated result agrees with the pressure-volume relationship according to the Boyle's Law.

Instrumentation changes as science progresses, comments on it?

- If any instrumentation changes occur, the internal validity of the main conclusion is affected as alternative explanations are readily available.
- The instrumentation, or if dropping out leads to relevant bias between groups, a whole class of alternative explanations is possible that account for the observed differences.
- If any instrumentation changes occur, the internal validity of the main conclusion is affected, as alternative explanations are readily available

The water level in an aquarium decreases slowly even though the tank does not leak. What change of state is occurring?

- The volume of the liquid gradually decreases and finally no more of the liquid is left.
- This is because liquids constantly change into gas or vapours even when the temperature is less than the boiling point of a liquid.
- In evaporation, some molecules in the liquid break away and enter the gas or vapour state.

What types of attractive forces do you expect between the molecules of HF and HCl?

Hydrogen fluoride (HF):

The H-bond in HF is so strong that the molecules remain associated through H-bonding even in the gaseous state.

Dipole-Dipole Forces in HCl:

The attractive forces between positive end of one polar molecule and negative end of other polar molecule are known as dipole-dipole forces.

Name two substances that are solids at 25°C. Name two substances that are liquid at 25°C.

Solid at 25°C = Sodium Chloride (NaCl) and Silver Nitrate (AgNO₃)

Liquid at 25°C = Water and Ethanol

Identify the process occurring in each of the following

Mothballs slowly disappear

Sublimation

A cold windshield becomes covered with ice when struck by Raindrops

Condensation

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

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An autoclave is used to sterilize surgical equipment. It is far more effective to produce steam by autoclave than steam produced from boiling water in the open atmosphere, because it generates steam at a pressure of two atmospheres. Explain why an autoclave is such an efficient sterilization device.

When the pressure of atmosphere is 1 atm or 101.325 kPa water boils at 100°C at sea level. This is because at this temperature vapour pressure of water is 1 atm or 101.325 kPa.

When vapour pressure of water becomes 2 atm then the temperature reaches 120°C. So water boils at 120°C in a autoclave and produces more steam in less time. Due to high pressure autoclave is more effective to produce steam as compare to boiling water in the open atmosphere (1 atm)

THEORY

Freeze dried foods are light weight and can be conveniently re-constituted by adding water. How?

Freeze drying is a dehydration process typically used to preserve a perishable material or make the material more convenient for transport. Freeze drying works by freezing the material and then reducing the surrounding pressure to allow the frozen water in the material to sublimate directly from the solid phase to the gas phase.

Define Pressure. What is its unit?

Force exerted by a gas on unit area of a container is called its pressure. Its unit is pascal (Pa).

Why gases are compressible?

Gases are compressible due to presence of large empty spaces between the gas molecules.

What do you know about the mobility of gases?

Gases have tendency to expand and fill the entire available space. So these can be transported through pipes over long distances.

What do you know about the density of gases?

Gases have very low densities under normal conditions. This is due to large spaced between gas molecules.

Define gas laws?

The relationship that expresses the influence of one variable on another with the two variable constant are called gas laws.

State and explain Boyle's law?

Volume of a fixed amount of gas at a given temperature is inversely proportional to the applied pressure.

$$\begin{aligned} p & \propto \frac{1}{v} \\ p & = \frac{1}{v} \times \text{constant} \\ p \times v & = \text{constant} \end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 5)

State and explain Charles's law?

Volume of given mass of a gas varies directly with absolute temperature at constant pressure.

$$\begin{array}{rcl} V & \propto & T \\ V & = & \text{constant} \times T \\ V/T & = & \text{constant} \end{array}$$

When you put nail polish remover on your palm, you feel a sensation of coldness.

The chemical nail polish remover is very volatile, it evaporates very quickly. To change from a liquid state, to a gaseous state takes energy. The warmth of your palm supplies the energy. The flow of heat is from your palm and into the liquid. This removes heat from your palm and has the sensation of being cool.

Does vapour pressure depend upon the nature of a liquid?

Yes it depends. The vapour pressure of a liquid decreases when inter molecular forces increases.

Define distillation.

A process called distillation is used to purify the liquids. It is a process in which a liquid is heated to vapourize it and the vapours are cooled to condense them back to the liquid in a different container.

What are allotropic forms of sulphur?

Rhombic Sulphur, Monoclinic Sulphur and Plastic Sulphur

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

REVIEW QUESTION

Differentiate between saturated and unsaturated solution?

Saturated solution:

The solution which **cannot dissolve more solute** at a particular temperature is called a saturated solution.

Unsaturated solution:

A solution which **can dissolve more of the solute** at a given temperature is called an unsaturated solution.

Give example of a solid solution containing two solids.

- **Brass** is an alloy of **copper** and **zinc**.
- **Steel** is an alloy of **iron** containing small amounts of **carbon** and **silicon**.

Can you call collides a solution?

Yes, collides are heterogeneous solution. For example:

- i) Starch solution
- ii) White of an egg.
- iii) Gelatin, glue, gums Milk, rubber, fog, dust in the air, jellies, paints, blood and starch in water.

Gasoline does not dissolve in water, why?

- Gasoline and oils do not dissolve in water.
- Gasoline and oil molecules are non-polar in nature.
- The attraction between a water molecule and oil or gasoline molecule is very weak so these liquids are insoluble in water.

Are gem stones solutions?

- Yes, many naturally occurring gemstones are solid solutions.
- For example Ruby, Opal, in these solutions a solid solute dissolves in a solid solvent.
- We call these solutions as solids in solids.

A tiny crystal of a solid substance is added to an aqueous solution of the same substance. What would happen if the original solution was a) super saturated b) unsaturated c) saturated

- a) Crystallization will start.
- b) Tiny crystal of a solid substance will again dissolve
- c) Tiny crystal of a substance start settling down at the bottom.

Explain why CH_3OH is soluble in water but C_6H_6 is not.

- Methanol (CH_3OH) is soluble in water due to hydrogen bonding.
- The general principle is "Like dissolve like".
- As water is polar solvent and Benzene is non polar, therefore benzene will not dissolve in water.

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

How can prepare 250 cm³ of 0.5M MgSO₄ from stock solution of 2.5M MgSO₄?

M ₁	=	molarity of given MgSO ₄	=	2.5M
V ₁	=	volume of MgSO ₄ need to dilute	=	?
M ₂	=	molarity of required MgSO ₄	=	0.5M
V ₂	=	volume of required MgSO ₄	=	250cm ³

$$M_1V_1 = M_2V_2$$

$$V_1 = \frac{M_2V_2}{M_1}$$

$$V_1 = \frac{0.5 \times 250}{2.5}$$

$$V_1 = \frac{125}{2.5} = 50 \text{ cm}^3$$

Give examples of the following:

a) a liquid solution of a liquid solvent and gaseous solute

Soda water, hydrochloric acid

b) a solid solution of two solids

- Brass is an alloy of copper and zinc.
- Steel is an alloy of iron containing small amounts of carbon and silicon.

What is the molarity of a solution prepared by dissolving 1.25g of HCl gas into enough water to make 30cm³ of solution.

Mass of solute HCl	=	1.25g	
Molar Mass of solute HCl	=	1 + 35.5	= 36.5g
Volume of Solution	=	30cm ³	

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$\text{Molarity} = \frac{1.25}{36.5} \times \frac{1000}{30}$$

$$\text{Molarity} = \frac{1250}{1095} = 1.14\text{M}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

Formalin is an aqueous solution of formaldehyde (HCHO), used as a preservative for biological specimens. A biologist wants to prepare 1dm³ of 11.5M formalin. What mass of formaldehyde he requires?

$$\begin{aligned}\text{Volume of Solution} &= 1 \text{ dm}^3 = 1000 \text{ cm}^3 \\ \text{Molarity} &= 11.5 \text{ M} \\ \text{Molar Mass of solute (HCHO)} &= 1+12+1+16 = 30 \text{ g}\end{aligned}$$

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$11.5 = \frac{\text{Mass of solute}}{30} \times \frac{1000}{1000}$$

$$11.5 = \frac{\text{Mass of solute}}{30}$$

$$\text{Mass of solute} = 11.5 \times 30 = 345 \text{ g}$$

A solution of Ca(OH)₂ is prepared by dissolving 5.2mg of Ca(OH)₂ to a total volume of 1000cm³. Calculate the molarity of this solution.

$$\begin{aligned}\text{Mass of solute Ca(OH)}_2 &= 5.2 \text{ mg} = 5.2/1000 = 0.0052 \text{ g} \\ \text{Molar mass of Ca(OH)}_2 &= 40+2 \times 16+2 \times 1 = 40+32+2 = 74 \text{ g} \\ \text{Molarity} &= ?\end{aligned}$$

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$\text{Molarity} = \frac{0.0052}{74} \times \frac{1000}{1000}$$

$$\text{Molarity} = \frac{0.0052}{74} = 0.00007 = 7 \times 10^{-5} \text{ M}$$

Calculate the number of moles of solute present in 1.25cm³ of 0.5M H₃PO₄ solution.

$$\begin{aligned}\text{Volume of solution in dm}^3 &= 1.25/1000 = 0.00125 \text{ dm}^3 \\ \text{Molarity} &= 0.5 \text{ M} \\ \text{Number of Moles} &= ?\end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

$$\text{Molarity} = \frac{\text{Number of moles}}{\text{Volume of solution in dm}^3}$$

$$0.5 = \frac{\text{Number of moles}}{0.00125}$$

$$\text{Number of moles} = 0.5 \times 0.00125 = 0.00063 = 6.3 \times 10^{-4} \text{ moles}$$

Calculate the new molarity when 100 cm³ of water is added to 100 cm³ of 0.5M HCl.

M ₁	=	new molarity	=	?
V ₁	=	volume of solution	=	100+100 = 200cm ³
M ₂	=	molarity of HCL given	=	0.5M
V ₂	=	volume of HCL	=	100cm ³

$$M_1 V_1 = M_2 V_2$$

$$M_1 = \frac{M_2 V_2}{V_1}$$

$$M_1 = \frac{0.5 \times 100}{200} = \frac{0.5}{2} = 0.25M$$

How are solutions useful for society? Give three examples.

- We use many solution substances in our daily life such as air, soft drinks, juices, shampoo, petrol, natural gas, diesel, kerosene, cough syrup etc.
- Most of the chemical reactions that take place in the bodies of living organisms occur in aqueous solutions.
- Brass, steel, german silver are also solutions. These are widely used for making cooking utensils, surgical tools, cutlery, musical instruments and many other objects.

A 10g of solid solute is placed in 100 g of water at 20°C and all of it dissolves. Then another 4g of the solute is added at 20°C and all of it dissolves.

- Is the first solution saturated, unsaturated or supersaturated?**
- Is it possible to tell from this information that the final solution is unsaturated or saturated?**
 - Unsaturated.
 - Unsaturated. Because a solution which can dissolve more of the solute at a given temperature is called an unsaturated solution.

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

What should you do to change:

- a) a saturated solution to an unsaturated solution.
- b) an unsaturated solution to a saturated solution.
- a) i) Add more solvent.
ii) Increase temperature.
- b) Keep adding solute until the solvent cannot dissolve any more at that given temperature.

Knowing the molarity of a solution is more meaningful than knowing whether a solution is dilute or concentrated. Explain.

Knowing the molarity is more meaningful because by knowing it you can not only know if it is diluted or concentrated, but also the actual concentration.

Design an experiment to determine the solubility of table sugar in water at room temperature.

- Prepare saturated solution of sugar in 100g of water.
- Take this solution in a pre-weighed china dish.
- Place china dish on the burner and heat it slowly till water evaporates completely.
- Cool china dish and weigh it.
- Calculate the mass of sugar present in it.
- Solubility of sugar in 100g of water at room temperature is 204g.
- Solubility of Sodium Chloride and Sucrose in Water from 0-100°C

Design an experiment to prepare 10% mass by volume solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (nelathota).

If we dissolve 10g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (Nelathota) in sufficient water to make 100 cm^3 solution, the resulting solution will be 10% m/v.

Which solution is more dilute 50 cm^3 of 0.2M NaOH or 100 cm^3 of 0.1M NaOH.

Case 1:

Volume of solution in dm^3 = $50/1000$ = 0.05 dm^3

Molarity = 0.2 M

Number of moles = ?

Molarity = $\frac{\text{Number of Moles}}{\text{Volume of solution in } \text{dm}^3}$

0.2 = $\frac{\text{Number of Moles}}{0.05}$

Number of Moles = 0.2×0.05 = 0.01 moles.

Case 2:

Molarity = $\frac{\text{Number of Moles}}{\text{Volume of solution in } \text{dm}^3}$

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

$$0.1 = \frac{\text{Number of Moles}}{0.1}$$

$$\text{Number of Moles} = 0.1 \times 0.1 = 0.01 \text{ moles.}$$

Which solution is more concentrated 100cm³ of 0.1M HCl or 100cm³ of 0.1M NaOH.

Case 1:

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$0.1 = \frac{\text{Mass of HCl}}{36.5} \times \frac{1000}{100}$$

$$0.1 = \frac{\text{Mass of HCl}}{36.5} \times 10$$

$$\text{Mass of HCl} = \frac{0.1 \times 36.5}{10} = 0.365\text{g}$$

Case 2:

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$0.1 = \frac{\text{Mass of NaOH}}{40} \times \frac{1000}{100}$$

$$0.1 = \frac{\text{Mass of HCl}}{40} \times 10$$

$$\text{Mass of HCl} = \frac{0.1 \times 40}{10} = 0.4\text{g}$$

Decision:

Since mass of NaOH is greater than HCl, therefore 0.1M NaOH is more concentrated.

Benzene is a common organic solvent. Its use is now restricted because this can cause cancer. The recommended limit of exposure to benzene is 0.32 mg per dm³ of air. Calculate the molarity of this solution.

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

$$\begin{aligned}
 \text{Mass of solute } C_6H_6 &= 0.32\text{mg} = 0.32/1000 = 0.00032\text{g} \\
 \text{Molar mass of } C_6H_6 &= 6 \times 12 + 1 \times 6 = 72 + 6 = 78\text{g} \\
 \text{Volume of solution} &= 1\text{dm}^3 = 1000\text{cm}^3 \\
 \text{Molarity} &= ?
 \end{aligned}$$

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$\text{Molarity} = \frac{0.00032}{78} \times \frac{1000}{1000}$$

$$\text{Molarity} = \frac{0.00032}{78} = 0.000004\text{M} = 4 \times 10^{-6}\text{M}$$

A patient in a hospital is often administered an intravenous (IV) drip containing an aqueous solution. This aqueous solution contains 0.85% (mass by volume) of sodium chloride or 5% (mass by volume) of glucose. Calculate the molarity of both these solutions.

Case 1:

$$\begin{aligned}
 \text{Mass of solute} &= 0.85\text{ g} \\
 \text{Molar mass of NaCl} &= 23 + 35.5 = 58.5\text{ g/mol}
 \end{aligned}$$

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$\text{Molarity} = \frac{0.85}{58.5} \times \frac{1000}{1000} = 0.145\text{ M}$$

Case 2:

$$\begin{aligned}
 \text{Molarity solute} &= 5\text{ g} \\
 \text{Volume of Solution} &= 100\text{ cm}^3 \\
 \text{Molar mass of glucose} &= 12 \times 6 + 1 \times 12 + 16 \times 6 = 180\text{ g/mol}
 \end{aligned}$$

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

$$\text{Molarity} = \frac{5}{180} \times \frac{1000}{100} = 0.278\text{ M}$$

100 cm³ of NaOH solution was heated to complete dryness, 1.5 g residue left behind. What was the molarity of the solution.

CHEMISTRY FOR 9TH CLASS (UNIT # 6)

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Molar mass of solute NaOH = 23+16+1 = 40 g
 Volume of solution = 100 cm³
 Molarity (M) = ?

Molarity = $\frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$

Molarity = $\frac{1.5}{40} \times \frac{1000}{100} = 0.375 \text{ M}$

THEORY

What is solute and solvent?

- In a solution, substance that is present in lesser amount is called solute.
- In a solution, substance that is present in larger amount is called solvent.

What is supersaturated solution?

A solution that contains more of the solute than is contained in a saturated solution is called supersaturated solution.

What do you know about ozone?

Ozone is found in upper atmosphere. It has an important biological function. It presents most of sun's ultraviolet solar radiations from reaching the earth. Long exposure to these radiation can cause cancer.

Define the following terms:

Fog:

Fog is a solution of water vapours in air.

Rectified Spirit:

Fermentation of cane sugar produces 95% v/v of ethyl alcohol called rectified spirit.

Amalgam:

The metal mercury is the only metal that is liquid at room temperature. It dissolves a number of metals to give a solution called amalgam.

Solubility:

The amount of solute that dissolves in 100g of solvent at a particular temperature is called its solubility.

True Solution:

A true solution is a homogeneous mixture in which the particles are individual molecules or ions distributed evenly throughout the surrounding fluid.

Suspension:

Such a heterogeneous mixture containing particles large enough to be seen with naked eye and clearly distinct from fluid is called suspension.

Colloid:

A heterogeneous mixture of tiny particles of a substance dispersed through a medium is called colloid.

Alloy:

Most commercial metals are examples of solid solutions of various metals and are called alloys. For example brass.

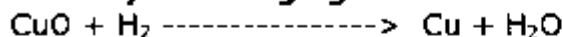
CHEMISTRY FOR 9TH CLASS (UNIT # 7)

REVIEW QUESTION

What is oxidation state?

Oxidation state or oxidation number is defined as the number of charges an atom will have in a molecule or a compound.

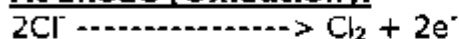
Identify reducing agent in the following reaction.



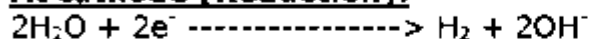
Because the oxidation number of Cu decreases (+2 to 0), so CuO₂ is an oxidizing agent. Similarly the oxidation number of H increases (0 to +2), therefore H₂ is reducing agent.

Write chemical reactions that occur in Nelson's cell.

At anode (Oxidation):



At cathode (Reduction):



Why tin plated steel is used to make food cans?

Food and beverages industries use tinned steel cans because the components of food beverages and the preservatives contain organic acids or their salts. They may form toxic substances by reacting with iron. These acids and salts are corrosive. Tin plating is nonpoisonous and prevents corrosion.

Explain one example from daily life which involves oxidation reduction reaction?

Redox in photography:

- A photographic film is basically an emulsion of silver bromide, (AgBr) in gelatin.
- When the film is exposed to light, silver bromide granules become activated.
- Exposed film is placed in the developer solution (Hydroquinone) that is actually a reducing agent.
- In hydroquinone the activated granules of silver bromide are reduced to black metallic silver.
- Inactivated silver bromide is removed from the film by using a solvent (Sodium thiosulphate) called a fixer.
- The areas of the film exposed to the light appear darkest because they have the highest concentration of metallic silver.
- Thus photography involves oxidation-reduction reaction.

Define oxidation and reduction in terms of loss or gain of oxygen or hydrogen.

Oxidation:

Gain of oxygen
Loss of hydrogen

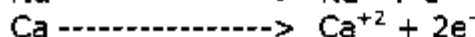
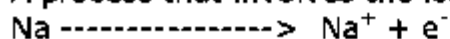
Reduction

Loss of oxygen
Gain of hydrogen

Define oxidation and reduction in terms of loss or gain of electrons.

Oxidation:

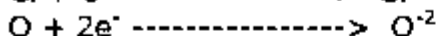
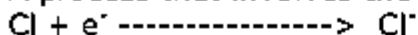
A process that involves the loss of electrons by an element is called oxidation.



CHEMISTRY FOR 9TH CLASS (UNIT # 7)

Reduction:

A process that involves the gain of electrons by a substance is called reduction.



List the possible uses of electrolytic cell.

- Down's Cell is used for the commercial preparation of sodium metal. It produces chlorine gas as by product.
- Nelson's Cell is used for the commercial preparation of sodium hydroxide. It also produces chlorine and hydrogen gas as by product.
- Electrolytic cells are used for the commercial preparation of calcium and magnesium metals.
- It is used to produce aluminum metal commercially.
- It is used for the purification of copper.
- Electrolytic cells are used to electroplate metals such as tin, silver, nickel etc.
- Electrolytic cells are used to prepare anodized aluminum. Anodized aluminum can absorb dyes.

Describe how a battery produces electrical energy.

- A battery is a galvanic cell or a group of galvanic cells joined in series.
- It generates electric current by a redox reaction.
- When connected in a circuit its anode oxidizes by releasing electrons.
- These electrons through the external circuit begin to flow towards the cathode.
- At cathode these electrons reduce oxidizing agent present in the electrolyte.

Describe the method of recovering metal from its ores.

- The process of producing a metal from its ores, always involves oxidation reduction reaction.
- Most of the metals are found in nature as oxides or sulphide ores.
- After mining the ore, desired mineral is separated from the other materials.
- Purified metal oxides are reduced to free metals by using a reducing agent.

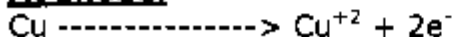
Explain electrolytic refining of copper.

- The copper metal obtained from its ores is usually impure.
- It contains impurities such as zinc, iron, silver and gold. These impurities are removed by the process of electrolysis.
- In this process impure copper bars act as anode and pure copper bars as cathode.
- CuSO_4 solution containing little sulphuric acid is used as the electrolyte.

Working:

- On passing electricity copper anode dissolves forming Cu^{+2} ions.
- Cations move towards the cathode at which only Cu^{+2} ions are reduced.
- Thus pure copper deposits at cathode.
- The less electropositive metals silver and gold fall to the bottom of the cell.
- Copper obtained in this process is 99.5% pure.
- Following reaction occur in this process:

At anode:



At cathode:



CHEMISTRY FOR 9TH CLASS (UNIT # 7)

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Explain how food and beverage industries deal with corrosion.

- Tin plated steel is used to make cans.
- Food and beverages industries use tin-plated steel cans. This is because the components of food beverages and the preservatives contain organic acids or their salts. They may form toxic substances by reacting with iron. These acids and salts are corrosive.
- Tin plating is nonpoisonous and prevents corrosion.

Differentiate between Electrolytic and Galvanic Cell.

Electrolytic Cell:

- Electrical energy is converted into chemical energy.
- Current is used to drive chemical reaction.
- Non-Spontaneous oxidation-reduction reaction takes place.
- Electrolysis takes place.
- Examples are Down's cell, Nelson's cell

Galvanic Cell:

- Chemical energy is converted into electrical energy.
- Current is produced due to chemical reaction.
- Spontaneous oxidation-reduction reaction takes place.
- Electronic Conduction takes place.
- Examples are Daniel cell, fuel cell.

Define oxidation number or oxidation state.

- Oxidation state or oxidation number is defined as the number of charges an atom will have in a molecule or a compound.
- The elements that show an increase in oxidation number are oxidized. The elements that show a decrease in oxidation number are reduced

Find the oxidation state of nitrogen in the following compounds. (i) NO₂ (ii) N₂O (iii) N₂O₃ (iv) HNO₃

Oxidation number of N in NO₂:

The sum of oxidation numbers must be zero.

$$\begin{aligned} [\text{Oxidation No. of N}] + 2[\text{Oxidation No. of O}] &= 0 \\ [\text{Oxidation No. of N}] + 2[-2] &= 0 \\ [\text{Oxidation No. of N}] - 4 &= 0 \\ [\text{Oxidation No. of N}] &= +4 \end{aligned}$$

Oxidation number of N in N₂O:

The sum of oxidation numbers must be zero.

$$\begin{aligned} 2[\text{Oxidation No. of N}] + [\text{Oxidation No. of O}] &= 0 \\ 2[\text{Oxidation No. of N}] + [-2] &= 0 \\ 2[\text{Oxidation No. of N}] - 2 &= 0 \\ 2[\text{Oxidation No. of N}] &= 2 \\ [\text{Oxidation No. of N}] &= 2/2 = +1 \end{aligned}$$

CHEMISTRY FOR 9TH CLASS (UNIT # 7)

Oxidation number of N in N₂O₃:

The sum of oxidation numbers must be zero.

$$\begin{aligned} 2[\text{Oxidation No. of N}] + 3[\text{Oxidation No. of O}] &= 0 \\ 2[\text{Oxidation No. of N}] + 3[-2] &= 0 \\ 2[\text{Oxidation No. of N}] - 6 &= 0 \\ 2[\text{Oxidation No. of N}] &= 6 \\ [\text{Oxidation No. of N}] &= 6/2 = +3 \end{aligned}$$

Oxidation number of N in HNO₃:

The sum of oxidation numbers must be zero.

$$\begin{aligned} [\text{Oxidation No. of H}] + [\text{Oxidation No. of N}] + 3[\text{Oxidation No. of O}] &= 0 \\ [+1] + [\text{Oxidation No. of N}] + 3[-2] &= 0 \\ +1 + [\text{Oxidation No. of N}] - 6 &= 0 \\ [\text{Oxidation No. of N}] - 5 &= 0 \\ [\text{Oxidation No. of N}] &= 5 \end{aligned}$$

Find the oxidation state of S in the following compounds. (a) H₂S (b) H₂SO₃ (c) Na₂S₂O₃

Oxidation number of S in H₂S:

The sum of oxidation numbers must be zero.

$$\begin{aligned} [\text{Oxidation No. of S}] + 2[\text{Oxidation No. of H}] &= 0 \\ [\text{Oxidation No. of S}] + 2[+1] &= 0 \\ [\text{Oxidation No. of S}] + 2 &= 0 \\ [\text{Oxidation No. of S}] &= -2 \end{aligned}$$

Oxidation number of S in H₂SO₃:

The sum of oxidation numbers must be zero.

$$\begin{aligned} 2[\text{Oxidation No. of H}] + [\text{Oxidation No. of S}] + 3[\text{Oxidation No. of O}] &= 0 \\ 2[+1] + [\text{Oxidation No. of S}] + 3[-2] &= 0 \\ +2 + [\text{Oxidation No. of S}] - 6 &= 0 \\ [\text{Oxidation No. of S}] - 4 &= 0 \\ [\text{Oxidation No. of S}] &= +4 \end{aligned}$$

b: Oxidation number of S in Na₂S₂O₃:

The sum of oxidation numbers must be zero.

$$\begin{aligned} 2[\text{Oxidation No. of Na}] + 2[\text{Oxidation No. of S}] + 3[\text{Oxidation No. of O}] &= 0 \\ 2[+1] + 2[\text{Oxidation No. of S}] + 3[-2] &= 0 \\ +2 + 2[\text{Oxidation No. of S}] - 6 &= 0 \\ 2[\text{Oxidation No. of S}] - 4 &= 0 \\ 2[\text{Oxidation No. of S}] &= 4 \\ [\text{Oxidation No. of S}] &= 4/2 = +2 \end{aligned}$$

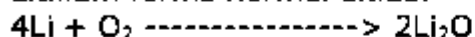
CHEMISTRY FOR 9TH CLASS (UNIT # 8)

REVIEW QUESTION

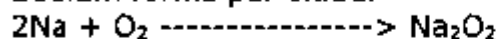
In a group the reactivity of metals with oxygen increases? Give example.

In a group the reactivity of metals with oxygen increases. For example, alkali metals on exposure to air show an increase in affinity for oxygen as we move down the group.

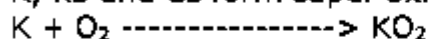
Lithium forms normal oxide.



Sodium forms per oxide.



K, Rb and Cs form super oxide.



In periods as we move from left to right, reactivity of metals with oxygen decreases. Explain.

In periods as we move from left to right, reactivity of metals with oxygen decreases.

Examples:

- In the third period sodium readily reacts with oxygen to form sodium peroxide, at room temperature.
- Mg reacts with oxygen only on ignition.
- Al reacts with oxygen on heating. It is superficially oxidized at room temperature to form Al_2O_3 layer which serves as a protective covering that prevents further reaction.

Which element is more metallic Mg or Al? Explain.

Mg is more metallic than Al.

What is the importance of Mg?

- Magnesium has relatively low density and it is used in making light weight alloy with aluminum that are used for making frames of automobiles, air craft and space ship, cameras etc.
- Since magnesium burns brilliantly, it is used in photo flash guns.
- $\text{Mg}(\text{OH})_2$ is called milk of magnesia and is commonly used as antacid.

Arrange the following in order of increasing acidic strength.



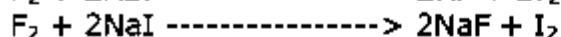
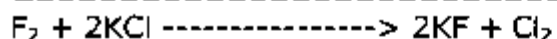
Can F_2 oxidize air the halides ions to free halogen?

- Yes, F_2 can oxidize all the halides ions to free halogen.
- Oxidizing power of F_2 is the highest and that of I_2 is lowest.
- Due to the relative strength as oxidizing agent, it is possible for a free halogen to oxidize the ion of halogen next to it in the group.
- This means F_2 can oxidize all the halide ions to free halogen.

For example:

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CHEMISTRY FOR 9TH CLASS (UNIT # 8)



Arrange the following oxides in order of decreasing basic character. BeO, CaO, MgO, SrO



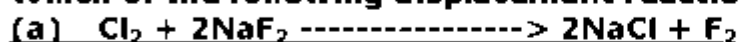
Rank the each set of elements in order of increasing metallic character. (a)

Al, Na, Mg (b) Na, Li, K

a) $\text{Na} < \text{Mg} < \text{Al}$

b) $\text{Li} < \text{Na} < \text{K}$

Which of the following displacement reaction will not occur? Give reason.



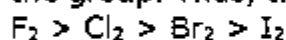
Displacement reaction will not occur because the reactivity of halogens decrease down the group. Thus, the order of decreasing power oxidizing is:



Therefore Cl_2 cannot oxidized F_2 .



Displacement reaction will occur because the reactivity of halogens decrease down the group. Thus, the order of decreasing power oxidizing is:



Therefore Br_2 can oxidized Br_2 .



Displacement reaction will not occur because the reactivity of halogens decrease down the group. Thus, the order of decreasing power oxidizing is:



Therefore h cannot oxidized Br_2 .

Give some important applications of platinum.

- Platinum is widely used as catalyst.
- For example, 100% pure sulphuric acid is prepared by the contact process. In this process platinum is used as catalyst.
- Platinum is used as electrode as a part of hydrogen electrode and in fuel cells.
- The converters in automobile contain platinum for complete combustion of CO and hydrocarbons.
- A platinum compound called cis-platin is useful as an anti cancer agent.

Identify the position of potassium and calcium in the periodic table.

- Potassium is group I-A element known as alkali metal.
- Potassium has general electron configuration ns^1 in its valence shell.
- Calcium is group II-A element is known as alkaline earth metal.
- Calcium has general electron configuration ns^2 in its valence shell.

CHEMISTRY FOR 9TH CLASS (UNIT # 8)

What is aqua regia?

Gold and platinum react only with aqua regia. Aqua regia is a mixture of 3 parts by volume of conc. HCl and one part by volume of conc. HNO₃.

Why it is advisable, not to pick sodium metal with fingers.

- Sodium reacts violently with water (moisture of fingers) often catching fire and exploding.
- This reaction produces sodium hydroxide, a strong and caustic base.

Arrange the following elements in order of increasing non-metallic character.
Al < Si < P

Design an experiment to show that iron is more reactive than copper.

- When iron is added to copper sulphate solution the copper is displaced by the iron.
- Copper metal cannot be used to displace iron because in reactivity series copper lies below iron.

Design an experiment to differentiate between Cl⁻ and I⁻.

Materials Need:

- Test tubes, glass rods.
- Chemical such as dilute H₂SO₄, conc. H₂SO₄, NH₄OH
- Salts containing Cl⁻ and I⁻.

Experiment:

- Take small quantity of each salt in separate dry test tubes. Add few drops of dilute H₂SO₄ solution. Note the test tube in which a gas evolves. Test each gas as follows.
- Take small quantities of remaining salts in dry test tubes and this time add few drops of concentrated H₂SO₄ heat, and analyze as follows.
- Note the salt that gives colourless gas having pungent odour. Test this gas with a glass rod dipped in liquid NH₃ or NH₄OH solution. It will give dense white fumes. It must be HCl. This indicates Cl⁻ ion. Note the salt that gives violet fumes having pungent odour. Test these vapours with starch paper, it will turn blue. This indicate I⁻ ion.

THEORY

When gold or platinum ornaments are placed in a moist air, they do not rust why?

The metals gold, silver and platinum are not affected by air. Therefore these are not rusted. More over they are durable and keep permanently, their metallic luster. They are not oxidized by environment.

Give the uses of copper?

It is widely used for making electrical cables, ornaments, coins and alloys such as brass, bronze etc.

CHEMISTRY FOR 9TH CLASS (UNIT # 8)

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Can copper metal be used to displace iron or other metals?

No, copper metal cannot be used to displace iron because in reactivity series copper lies below iron.

Write the uses of iodine in the daily life?

Iodine is an essential element for thyroid gland and an important disinfectant. It is used for making tincture iodine. Commercially it is prepared by the oxidation of iodide salt by Cl_2 .

Can Iodine displace Cl_2 or Br_2 from their salts?

Iodine (I_2) can not displace Cl_2 or Br_2 from their salts because in case of halogens oxidizing power of F_2 is the highest and that of I_2 is lowest.

What does periodic table tell you about reactivity of elements?

In groups as we move from top to bottom reactivity of metal with oxygen increases. In periods as we move from left to right reactivity of metal with oxygen decreases

Explain the electropositive character of the metals?

Chemically the property of an element that makes it a metal is its ability to lose valence electrons to form metal cation. The tendency of a metal to lose electrons is called electro positivity.

Why non-metals are electronegative?

- The tendency of a non metals to accept an electron to form an anion is called its non-metallic or electronegative character.
- The elements having high electron affinity or high electronegativity have higher tendency to gain electrons and form negative ion.
- The elements in the upper right hand portion of the periodic table are electronegative or non-metallic in nature.
- For example, fluorine, oxygen and phosphorus are non-metallic in nature. The electronegative character decreases as we go down in a group.

What do you know about Strontium-90?

Strontium-90, a radioactive Isotope, is a major product of an atomic bomb explosion. Constant exposure of the body to high energy radiations emitted by the Sr-90 can lead to anaemia, leukemia and other chronic illnesses

What do you mean by inertness of noble metals?

- Some metals such as copper, silver, gold and platinum are relatively difficult to oxidize.
- Therefore, these metals are often called noble metals.
- Gold and Platinum exist mostly as free elements in nature.
- Copper and Silver exist in both free and combined states.
- All active metals react with HCl but noble metals do not react with HCl.
- Copper and silver react with strong oxidizing agents such as conc. HNO_3 and HClO_4 .

CHEMISTRY FOR 9TH CLASS (UNIT # 8)

What is Rolled Gold?

Rolled gold is a thin layer of gold alloy that is bonded onto brass or nickel-silver alloy.

What do you know about microprocessor silicon chip?

- Computers exist because of an amazing invention called the integrated circuit known as the silicon chip or just chip.
- Chips are microprocessors which can perform all the function of a computer.
- These are so small that one will fit on the tip of your finger.
- A chip is made from a very thin flake of an element called silicon.
- Chips contain millions of working parts that are so small that they can be seen only with a microscope

What are halogens?

- The elements in group VII-A are called halogens.
- The name halogen is derived from the Greek words "halous" meaning salt and "gen" meaning former.
- Halogens include fluorine, chlorine, bromine, iodine and astatine. Astatine is a radioactive element.
- All halogens are reactive non-metals.
- They all exist as diatomic molecular substances

What are Halides?

All the halogens react with metals to form salts called halides.
